

# ACOUSTICS TECHNOLOGY IN LAND USE PLANNING

VOLUME 2  
ROAD TRAFFIC NOISE TABLES

JULY 1977

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Ministry  
of the  
Environment

The Honourable  
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Minister

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ACOUSTICS TECHNOLOGY IN  
LAND USE PLANNING

1977

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VOLUME 2 - ROAD TRAFFIC NOISE TABLES

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ROAD TRAFFIC NOISE TABLES

by

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## COMPARISON OF DESIGN CRITERIA

A comparison of design criteria used and which may be successfully used without altering the Tables, may be useful at this time:

- i) The design sound level limits for both the RED FLAGGING TABLES and the SOUND BARRIER TABLES are:-

$$\begin{array}{l} L_{eq}(24 \text{ hr}) = 55 \text{ dBA} \\ \hline L_{50}(24 \text{ hr}) = 52 \text{ dBA} \end{array}$$

- ii) The design sound level limits above have been shown to approximately equal the 16 hour daytime recommended design sound level limits proposed for new housing subdivisions in Ontario. (1,12,21,23)

- iii) Similarly;

$$\begin{array}{l} L_{eq}(24 \text{ hr}) 55 \text{ dBA} = L_{eq}(16 \text{ hr}) 55 \text{ dBA} \\ L_{eq}(24 \text{ hr}) 55 \text{ dBA} = L_{dn} 58 \text{ dBA} \\ L_{eq}(24 \text{ hr}) 55 \text{ dBA} = L_{eq} 57 \text{ dBA (Peak Hour)} \quad (24) \end{array}$$

where '16 hr' and 'Peak Hour'  $L_{eq}$  refer to daytime only.

- iv) Design guidelines published by the Ministry of Housing refer to  $L_{eq}$  (Peak Hour) sound level limits. (24)

- v) Inaccuracies resulting from rounding off data (see 4.6) permit use of these Tables in other jurisdictions where  $L_{dn}$  is the preferred sound descriptor, as follows.

Design sound level limit for Tables,  $L_{dn} = 60 \text{ dBA}$  (say)

- vi) Similarly, when impacts from road traffic noise and aircraft noise occur simultaneously the  $L_{dn}$  equivalent may be the preferred sound descriptor

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## FOREWORD

While the Ministry of Housing has the primary responsibility for administration of The Planning Act and The Condominium Act, technical assistance on acoustics and noise control is provided by the Ministry of the Environment which has as its mandate the obligation to preserve and enhance the natural environment. The recommended design sound level limits specified in these Road Traffic Noise Tables meet this objective.

The leading noise descriptor used in these Tables is the energy equivalent sound level ( $L_{eq}$  dBA). This descriptor has recently been used in many noise assessments carried out by this Ministry. In November, 1974, the Federal Department of the Environment requested that the Ontario Ministry of the Environment investigate the probable increase in sound levels due to the introduction of a GO Transit commuter service between downtown Toronto and Richmond Hill, utilizing an existing freight service rail line. To carry out this assignment, the energy equivalent sound level was used for the first time in Ontario to calculate and predict the noise impact due to this new rail service. This noise descriptor lends itself to the assessment of intrusive transportation noise while correlating well with human annoyance response.

In March, 1975, the energy equivalent sound level was also adopted as the noise descriptor in the Model Municipal Noise Control By-Law.<sup>(1)</sup> This was, perhaps, the first time that any Canadian jurisdiction had adopted the time varying energy averaged decibel level into the regulatory process. At the present time guidelines, criteria and procedures, particularly those related to the enforcement of The Environmental Protection Act, 1971 as amended, are based primarily on energy equivalent sound level determinations.

Experience gained over the past two years in assessing a large number of land use impact statements on behalf of the Ministry of Housing confirmed the efficacy of using the energy equivalent sound level in new residential subdivision noise assessment.

To enable this Ministry to cope with an ever increasing workload during a time of constraint and reduced resources, these Road Traffic Noise Tables were developed initially for use in the Regional Offices of the Ministry. The Tables represent a major step forward in providing a uniform and effective Provincial system to "red flag" land uses that may be subjected to noise impact. The Tables also offer the planner a selection of feasible noise control alternatives to meet acceptable design sound level criteria. Now, after a period of refinement, the information is being made available for public use.

It is the policy of the Ontario Government to stimulate and encourage new housing construction that is both adequate and affordable within a sound planning framework by easing red tape constraints on development, by simplifying the approvals process and by streamlining regulations that bear on new housing. In support of this policy, the Ministry of the Environment offers the Road Traffic Noise Tables as a tool in rationalizing the approvals process.

## 1. INTRODUCTION

Vehicular traffic is a major source of environmental noise pollution which may have an impact on the quality of life in populated areas. The effect of traffic noise in the urban environment is becoming an increasingly important consideration since noise is capable of interfering with human efficiency, personal comfort and the enjoyment of property. The introduction of The Environmental Protection Act, 1971, recognized sound and vibration as contaminants of the natural environment which may cause harm or material discomfort to persons or render property unfit for use by man.

There is a growing concern for the way that we use land. Planners, engineers, environmentalists and legislators are being challenged to create land use plans that will provide a controlled and healthy environment for present and future generations. As a result of this growing concern for the quality of the environment, land use planning with respect to noise and vibration has become one of the areas of interest of the Ontario Ministry of the Environment. At the present time, the Ministry acts in an advisory capacity in dealing with land use matters in order to ensure that the necessary environmental safeguards, including those controlling undue noise and vibration, are incorporated into land use policies and programs at all levels of government and in the private sector.

The Road Traffic Noise Tables are presented as part of a continuing effort by the Ministry of the Environment to promote sensible land use and site planning with respect to traffic noise and to provide general guidance to the private sector in developing or planning new housing projects.

While every effort has been made to ensure the accuracy of the Tables, neither the authors nor the Ministry of the Environment can accept any responsibility for errors or omissions.

## 2. SCOPE

The purpose of the Road Traffic Noise Tables and procedures is to ensure that whenever a new residential land development or redevelopment is proposed, appropriate noise control measures are promoted, if necessary, near to any existing or proposed vehicular traffic transportation corridor. Use of the Tables will reduce the noise impact on the proposed residential development to an acceptable level.

The Tables relate only to residential land use development and not to roadway design, although it is well recognized that the design and routing of new roadways, or expansion of existing ones, is equally as important in influencing the acoustical living environment in adjacent residential developments.

The Tables are concerned with noise emissions from vehicular traffic under certain defined conditions and assumptions. Two different sets of Tables are provided. The first set of Tables can be beneficially used by land use planners in Government and the private sector to "red flag" those land areas subjected to a significant noise impact. Those lands can then be used for a more compatible land use to be more closely investigated. The second set of Tables indicate to site planners the desirable forms of noise control measures (such as distance set back, barriers, buildings, or types of housing structure) which should be considered to reduce the sound levels in "red flagged" areas down to acceptable values. This second set of Tables only indicates the general concept required for the noise control measures on the site, further work within the general concept being required by the site planner and architect to bring the project to its final design stage.

The Tables apply primarily only to the new residential subdivisions proposed closest to an existing or proposed roadway. Subdivisions further from the roadway will generally be protected by the subdivision closest to the roadway, particularly if the subdivision is designed according to the information supplied in these Tables.

The selection of traffic flows of up to 220,000 vehicles per day in the Tables will cover the entire road system in the Province of Ontario although it is known that, on occasion, Highway 401 exceeds this upper limit in particular areas.<sup>(2)</sup> To account for the effects of grooving on concrete surfaced roadways (tyne cut or plastic brushed grooving), the traffic volume count is factored upwards by 3. (See Examples). For these particular stretches of roadway that are tyne cut or plastic brushed grooved, the actual daily traffic volume cannot exceed 64,000 vehicles per day to successfully use the Tables. For higher traffic volumes on these particular grooved stretches of roadway, noise impacts must be calculated independently using the equations provided in Section 8 remembering always to increase the traffic volume by a factor of three.

As a result of a recent policy decision, a tri-Ministry technical committee has been set up to establish noise guidelines for freeways (controlled access roads) in terms of noise attenuation features (barriers, etc.) that will be installed by the Ministry of Transportation and Communications, where practicable, and in terms of defining the developers responsibility for meeting noise guidelines in new residential subdivisions. This book will "red flag" potential problem areas due to traffic noise and will provide the site planner with alternatives in site design techniques to meet established Provincial noise guidelines.

The Ministry of Housing, under provisions of The Planning Act, has the responsibility for establishing the policy on sound level limits permitted in new residential subdivisions. The Ministry of the Environment cooperates in this endeavour and provides technical comment on new land uses.



Data Value	Table Value Used
m.p.h.	m.p.h.
%	%
%	%

Step 1: Speed =

Step 2: Truck Percent =

Step 3: Roadway Grade =

Step 4: Table to be used is

Step 5: 24 hour Traffic Volume =

Step 6: Grooving?

Yes, 24 hour Traffic Volume x 3 =

No, 24 hour Traffic Volume =

Step 7: Distance =

Step 8: dBA excess =

Total dBA excess =

Step 9: Subjective Change in Loudness:

Magnitude of Noise Problem:

Necessity of Control Measures:

Step 10: Distance for no Control Measures:  
(assuming flat land)

REMARKS:.

Fig. 3.1 RED FLAGGING DATA SHEET

### 3. HOW TO USE THE TABLES

#### 3.1 RED FLAGGING TABLES

This set of Tables allows prediction of the noise level on a site, expressed in terms of the number of dba in excess of the recommended design sound level limits. A further Table is then used (Fig. 3.3) to determine the subjective or apparent loudness of the traffic noise on the site, the extent of the noise problem and the necessity of investigating noise control measures.

Having obtained a blank Red Flagging data sheet (Fig. 3.1) the following procedure should be used:

Step 1: Determine the posted speed on the subject roadway (or operating speed, if known) and enter onto the Red Flagging data sheet.

Step 2: Determine the percentage of trucks (Trucks are defined as all vehicles with a Gross Vehicle Weight greater than 10,000 lbs.). If no truck percentage is known, assume 10%. Enter the Truck Percentage onto the Red Flagging data sheet.

Step 3: Determine the Roadway Grade expressed as a percentage. If the Roadway Grade is unknown, assume 0%. Enter the Roadway Grade and the Table Roadway Grade Range onto the Red Flagging data sheet.

Step 4: Determine the number of the Red Flagging Table to be used from the data established in Steps 1, 2 and 3 using Fig. 3.2. Enter the correct Table number on the Red Flagging

# RED FLAGGING TABLES INDEX

Excess Sound Level in dBA over Recommended\* Outdoor Sound Level Limits for Various Traffic and Roadway Parameter

Table No.	Combination of Traffic Parameters		
	Speed (mph)	% Truck	% Grade
1	40	10	0 to 3
2	40	10	4 to 6
3	40	10	7 +
4	40	20	0 to 3
5	40	20	4 to 6
6	40	20	7 +
7	50	10	0 to 3
8	50	10	4 to 6
9	50	10	7 +
10	50	20	0 to 3
11	50	20	4 to 6
12	50	20	7 +
13	60	10	0 to 3
14	60	10	4 to 6
15	60	10	7 +
16	60	20	0 to 3
17	60	20	4 to 6
18	60	20	7 +

\* For Recommended Limits, see Section 8.2 and Appendix B.

Figure 3.2

data sheet and find the correct Table. If the data does not correspond exactly to the Table values, consult Sections 3.1.1 and 3.1.2. which follow.

Step 5: Determine the daily (24 hour) Traffic Volume ten years hence. The largest of the Annual Average Daily Traffic (AADT), Summer Average Daily Traffic (SADT), the Summer Average Weekday Traffic (SAWDT), or the Winter Average Daily Traffic (WADT)<sup>(3)</sup> should be used. If only present day Traffic Volume is available, then this should be multiplied by 1.6 (5% per year for ten years) to give the volume assumed ten years hence. Enter the Traffic Volume ten years hence onto the Red Flagging data sheet. (See note below)

Step 6: Determine if the roadway is concrete surfaced and is plastic brush grooved or is to be transverse tyne cut grooved within the next ten years. If so, multiply the Traffic Volume ten years hence by 3 and enter this effective Traffic Volume on the Red Flagging data sheet. If no grooving is expected, or if diamond cut transverse grooving is expected re-enter the Traffic Volume from Step 5 onto the Red Flagging data sheet.

Step 7: Determine the distance (in feet) from the roadway edge of pavement (EOP) to the nearest wall of the row of normal housing nearest to the roadway. Enter the distance onto the Red Flagging data sheet.

Step 8: Using the data established in Steps 7 and 8, use the Table to determine the dBA excess over criteria values ( $L_E$ ). If the data does not correspond with the Table values, consult sections 3.1.2 and 3.1.4. Enter the dBA excess onto the Red Flagging data sheet.

NOTE: If the traffic volume ten years hence exceeds the traffic volume given by level of service C<sup>(3)</sup> then use the lesser.

Figure 3.3: Applying Recommended Sound Level Limits to Residential Land Use Developments.

Excess Above Recommended Sound Level Limits dBA	Change in Subjective Loudness Above Recommended Sound Level Limits	Magnitude of the Noise Problem	Noise Control Measures (or action to be taken)
No excess	--	No expected noise problem	None, see 3.1.5
1 to 5 inclusive	Noticeably louder	Slight noise problem	Optional (if no physical measures are taken then prospective purchasers or tenants should be made aware by a clause in the deed or rental agreement) see 3.1.6
6 to 10 inclusive	Almost twice as loud	Definite noise problem	Recommended, see 3.1.7
11 to 15 inclusive	Almost three times louder	Serious noise problem	Strongly Recommended, See 3.1.7
16 and over	Almost four times louder	Very serious noise problem	Strongly Recommended, See 3.1.7 (May be mandatory)

Step 9: Use Fig. 3.3 to determine from the dBA excess ( $L_E$ ) the subjective loudness above recommended sound level limits, the magnitude of the noise problem and the necessity of noise control measures. Enter these results onto the Red Flagging data sheet.

Step 10: If it is required to find at what distance no noise control measures will be required in the "flat land" situation use the data of Step 7 to find the correct row in the Table, trace this row from left to right until the first " - " is found, then trace this column vertically upwards to find the corresponding distance. Enter this distance onto the Red Flagging data sheet.)

#### 3.1.1 Rounding Off Data Values of Speed

The Red Flagging Tables are presented for speeds of 40, 50 and 60 mph. For speeds other than these, the following conversion table should be used (Fig. 3.4).

Data Value of Speed (mph)	Value to be Used (mph)
0 to 44	40
45 to 54	50
55 and up	60

Fig. 3.4

### 3.1.2 Rounding Off Data Values of Truck Percentage

The Red Flagging Tables are presented for truck percentages of 10% and 20%. For percentages other than these, the following conversion table should be used. (Fig. 3.5)

<u>Data Value of Truck Percentage</u>	<u>Value to be Used (%)</u>
0 to 14	10
15 and up	20

Fig. 3.5

### 3.1.3 Interpolation of 24 Hour Traffic Volume Values

The values of the 24 hour Traffic Volume have been incremented in the Table by multiplying by 1.5 (to give values of dBA excess separated by 2 dB, which may become 1 dB or 3 dB because of rounding). If the data value of the 24 hour Traffic Volume (factored up to include traffic growth in the next ten years and grooving<sup>(4)</sup> if necessary) does not approximate a Table value, then one of two procedures should be used:

- i) use the nearest value of Traffic Volume in the Tables;
- ii) initially use the nearest value of Traffic Volume in the Tables which is less than the data flow and interpolate upwards using the following formula:

$$\text{Traffic Volume Increment} = 10 \log \frac{\text{Data Traffic Volume}}{\text{Nearest Table Traffic Volume less than Data Volume}}$$

The Traffic Volume Increment should then be entered into the Red Flagging data sheet. Method (ii) will give greater accuracy but is, or course, more complicated than method (i).

#### 3.1.4 Interpolation of Distance Values

The values of Distance (from Edge of the Pavement to the nearest row of normal dwelling units) used in the Tables are again incremented by multiplying by 1.5 to give nominal 2 dB steps in the dBA excesses. If the data values of Distance do not approximate the Table values then one of two procedures should be used:

- i) use the nearest value of Distance in the Tables
- ii) initially use the nearest value of Distance in the Tables which is less than the data Distance and interpolate upwards using the following formula:

$$\text{Distance Increment} = 15 \log \frac{\text{Nearest Table Distance Less than Data Distance}}{\text{Data Distance}}$$

The Distance Increment should then be entered onto the Red Flagging Data Sheet. Method (ii) will give greater accuracy but is, of course, more complicated than method (i).



### 3.1.5 Procedure when dBA Excess (L) is denoted as " - "

In cases where notation " - " or a blank space is obtained from the Red Flagging Tables, there is no expected noise problem and thus no noise control measures will be necessary on the site under consideration. The site is acceptable for residential development with no necessity for considering noise control measures. (See note below)

### 3.1.6 Procedures when dBA Excess ( $L_E$ ) is 1 dBA to 5 dBA Inclusive

In cases where an excess between 1 dBA and 5 dBA inclusive is obtained from the Red Flagging Tables, two procedures are open to the developer:

- i) The subdivision can be completed with no noise control measures incorporated into the site, but prospective buyers and tenants advised of the slight noise problem. This should be done by incorporating the following clause (or one similarly worded) into both the initial Agreements of Purchase and Sale, and Deeds or Rental Agreements of all affected Units.

"Due to increasing traffic volumes, noise levels on this property are likely to become of concern, noise occasionally interfering with some activities of the occupants."

- ii) Investigate a more compatible land use or noise control measures as in Section 3.1.7.

NOTE: Although other noise sources are not discussed in this work, the planner must also consider train, aircraft and other noise sources impacting the site.

### 3.1.7 Procedures when dBA Excess ( $L_E$ ) is 6 dBA or More

---

In cases where a dBA excess ( $L_E$ ) of 6 dBA or more is obtained from the Red Flagging Tables, two procedures are open to the developer:

- i) Investigate a more compatible use for the land (or part of the land) under consideration. The report entitled "An Introduction to Noise and Its Control Through Planning" produced by the Local Policy Planning Branch of the Ministry of Housing could well be of interest and use in this respect.<sup>(5)</sup>
- ii) Investigate noise control measures for the land under consideration. The noise control measure of distance has already been investigated under Step 10 of the Red Flagging data sheet. Further noise control measures can be investigated using the Barrier Tables, which follow this section.

In projects where funding is provided under provisions of The National Housing Act (C.M.H.C.) reference should also be made to the technical publications of the Canada Central Mortgage and Housing Corporation.<sup>(6) (8)</sup>

### 3.1.8 Examples of the Use of the Red Flagging Tables

Example 1 (This example is also used as the example for the use of the Barrier Tables in section 3.2.2)

The following parameters were obtained:

Speed	55 mph
Truck Percentage	15%
Roadway grade	2%
Traffic Volume (10 years hence)	27,000 veh/day

The distance to be considered was 250 ft.

The completed data sheet follows; the traffic volume interpolation being thus:

Actual Traffic Volume	27,000
nearest Table Value of Traffic Volume	
<u>less</u> than data value	19,000

Traffic Volume Increment	=	$10 \log \frac{27,000}{19,000}$
	=	$10 \log 1.42$
	=	$10 \times 0.153$
	=	1.53
	=	2 dBA (to the nearest dBA)

# EXAMPLE 1

	Data Value	Table Value Used	
Step 1: Speed =	55 m.p.h.	60 m.p.h.	—see 3.1.1
Step 2: Truck Percent =	15 %	20 %	—see 3.1.2
Step 3: Roadway Grade =	2 %	0 to 3 %	—see Fig. 3.2
Step 4: Table to be used is	No. 16	from Fig. 3.2	
Step 5: 24 hour Traffic Volume =		27,000 veh/day	
Step 6: Grooving?			
Yes, 24 hour Traffic Volume x 3 =		veh/day	
<u>No.</u> 24 hour Traffic Volume =		27,000 veh/day	
Step 7: Distance =	250 ft.		
Step 8: dBA excess =	5 dBA		—from Table — for 19,000 veh/day.
	+ 2 dBA		Traffic Volume Interpolation—see 3.1.3
	— dBA		Distance Interpolation—see 3.1.4
Total dBA excess =	7 dBA		
Step 9: Subjective Change in Loudness:		Almost twice as loud	
Magnitude of Noise Problem:		Definite noise problem	
Necessity of Control Measures:		Recommended	
Step 10: Distance for no Control Measures: (assuming flat land)		1,300 ft.	See Fig. 3.

Result: Noise control measures required if closer than 1,300 ft.

Fig. 3.1.1 RED FLAGGING DATA SHEET

Example 2 (This example contains calculation of future traffic volumes, grooving, traffic volume interpolation and distance interpolation)

The following data were obtained:

Speed	40 mph
Truck Percentage	15%
Roadway Grade	5%
Percent day Traffic Volume	48,000
Projected increase	4% per year
The roadway is grooved	
Distance	140 ft.

The necessary calculations and completed Red Flagging Data sheet are as follows:

Projected increase in traffic volume	= 4% per year
10 year project increase in traffic volume	= $(1.04)^{10}$
	= 1.48
Traffic Volume 10 years hence	= 48,000 X 1.48
	= 71,052
Traffic Volume X 3 (grooved)	= 213,155
Traffic Volume interpolation, increment	= $10 \log \frac{213,155}{140,000}$
	= $10 \log 1.52$
	= $10 \times 0.18$
	= 1.8
	= 2 dBA (to the nearest dBA)
Distance interpolation, increment	= $15 \log \frac{110}{140}$
	= $15 \log 0.79$
	= $15 \times -0.105$
	= -1.57
	= -2 dBA (to the nearest dBA)

## EXAMPLE 2

	Data Value	Table Value Used	
Step 1: Speed =	40 m.p.h.	40 m.p.h.	—see 3.1.1
Step 2: Truck Percent =	15 %	20 %	—see 3.1.2
Step 3: Roadway Grade =	5 %	4 to 6 %	—see Fig. 3.2
Step 4: Table to be used is	No. 5	from Fig. 3.2	
Step 5: 24 hour Traffic Volume =		71,052 veh/day	
Step 6: Grooving?			
Yes, 24 hour Traffic Volume x 3 =		213,155 veh/day	
No, 24 hour Traffic Volume =		veh/day	
Step 7: Distance =	140 ft.		
Step 8: dBA excess =	20 dBA		—from Table for 140,000 veh/day and 110 feet
	+ 2 dBA		Traffic Volume Interpolation—see 3.1.3
	- 2 dBA		Distance Interpolation—see 3.1.4
Total dBA excess =	20 dBA		
Step 9: Subjective Change in Loudness:		Almost 4 times louder	See Fig. 3.3
Magnitude of Noise Problem:		Very serious noise problem	
Necessity of Control Measures:		Strongly recommended	
Step 10: Distance for no Control Measures: (assuming flat land)		- ft.	

This is an example of a serious noise problem resulting from high traffic flows.

Fig. 3.1.2 RED FLAGGING DATA SHEET

### 3.2 THE BARRIER TABLES

This set of Tables should only be used after the Red Flagging data sheet has been completed since the Barrier Tables allow the determination of what noise control measures (in the form of berm/wall combinations or barrier buildings) are required on the site under investigation. These Tables can be used either to plan the subdivision from it's conception or to see whether a proposed site plan can be adequately protected from excessive noise levels. The first stages in using the Barrier Tables are very similar to the initial steps in the Red Flagging Tables, the same data being used.

Having obtained a blank Barrier Table data sheet (Fig. 3.6), the following procedure should be used:

Step 1: Copy the data value of the Speed and the value used in the Red Flagging onto the Barrier Tables data sheet.

Step 2: Copy the data value of the Truck Percentage and the value used in the Red Flagging onto the Barrier Table data sheet.

Step 3: Copy the data value of the Roadway Grade and the range used in the Red Flagging onto the Barrier data sheet.

Step 4(a): Each Barrier Table is enumerated by two numbers. (See Fig. 3.7). The two numbers are separated by a dash, the first number being specified by the Speed, the Truck Percentage and the Roadway Grade %. Using the data already established, use Fig. 3.7 to give the first number of the Table enumeration. (As a check this number should be the same as the Table Number of the corresponding Red Flagging Table).

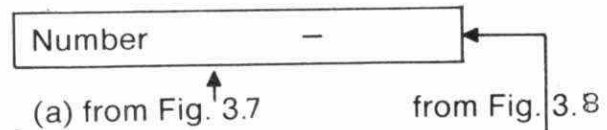
Step 1: Speed =

Step 2: Truck Percent =

Step 3: Roadway Grade =

Data Value	Table Value Used
m.p.h.	m.p.h.
%	%
%	%

Step 4: Table to be used is



(b) Traffic Volume =

Step 5: Distance =

Step 6: Road Elevation =

Data Value	Table Value Used
veh / day	veh / day
ft.	ft.
ft.	ft.

use minus sign for depressed road

Step 7:

		1st Row	2nd	3rd
Receiver Height (Floors)	1st			
	2nd			
	3rd			

Step 8: Data Value of Distance =

ft.	Table Value Used
+ 215 ft.	
ft.	ft.

∴ Increased Data Value of Distance =

		1st Row	2nd	3rd
Receiver Height (Floors)	1st			
	2nd			
	3rd			

REMARKS :

Fig. 3.6 BARRIER TABLES DATA SHEET



# SOUND BARRIER TABLES INDEX

Tables	Speed (mph)	% Truck	% Grade	Volume (Veh/Day)
1-4 through 1-12	40	10	0 to 3	8,400 through 220,000
2-3 " 2-12	40	10	4 to 6	5,600 " 220,000
3-3 " 3-12	40	10	7 +	5,600 " 220,000
4-3 " 4-12	40	20	0 to 3	5,600 " 220,000
5-3 " 5-12	40	20	4 to 6	5,600 " 220,000
6-2 " 6-12	40	20	7 +	3,800 " 220,000
7-2 " 7-12	50	10	0 to 3	3,800 " 220,000
8-2 " 8-12	50	10	4 to 6	3,800 " 220,000
9-2 " 9-12	50	10	7 +	3,800 " 220,000
10-2 " 10-12	50	20	0 to 3	2,500 " 220,000
11-1 " 11-12	50	20	4 to 6	2,500 " 220,000
12-1 " 12-12	50	20	7 +	3,800 " 220,000
13-1 " 13-12	60	10	0 to 3	2,500 " 220,000
14-1 " 14-12	60	10	4 to 6	2,500 " 220,000
15-1 " 15-12	60	10	7 +	2,500 " 220,000
16-1 " 16-12	60	20	0 to 3	2,500 " 220,000
17-1 " 17-12	60	20	4 to 6	2,500 " 220,000
18-1 " 18-12	60	20	7 +	2,500 " 220,000

Figure 3.7

Step 4(b) : The second number in the Table enumeration is set by the Traffic Volume. The value actually used should be the nearest Table value to the final 24 hour Traffic Volume used in the Red Flagging. These values should be entered onto the Barrier Table data sheet. The second number of the Table enumeration should now be obtained from Fig. 3.8

No interpolation is possible in the Barrier Tables for intermediate Traffic Volumes.

Table Value of 24 hour Traffic Volumes	Second Number in Table Enumeration
2,500	1
3,800	2
5,600	3
8,400	4
13,000	5
19,000	6
28,000	7
43,000	8
64,000	9
96,000	10
140,000	11
220,000	12

Fig. 3.8

#### Table Enumeration

The complete Table Number can now be entered in the Barrier Tables data sheet, and the relevant Barrier Table found.

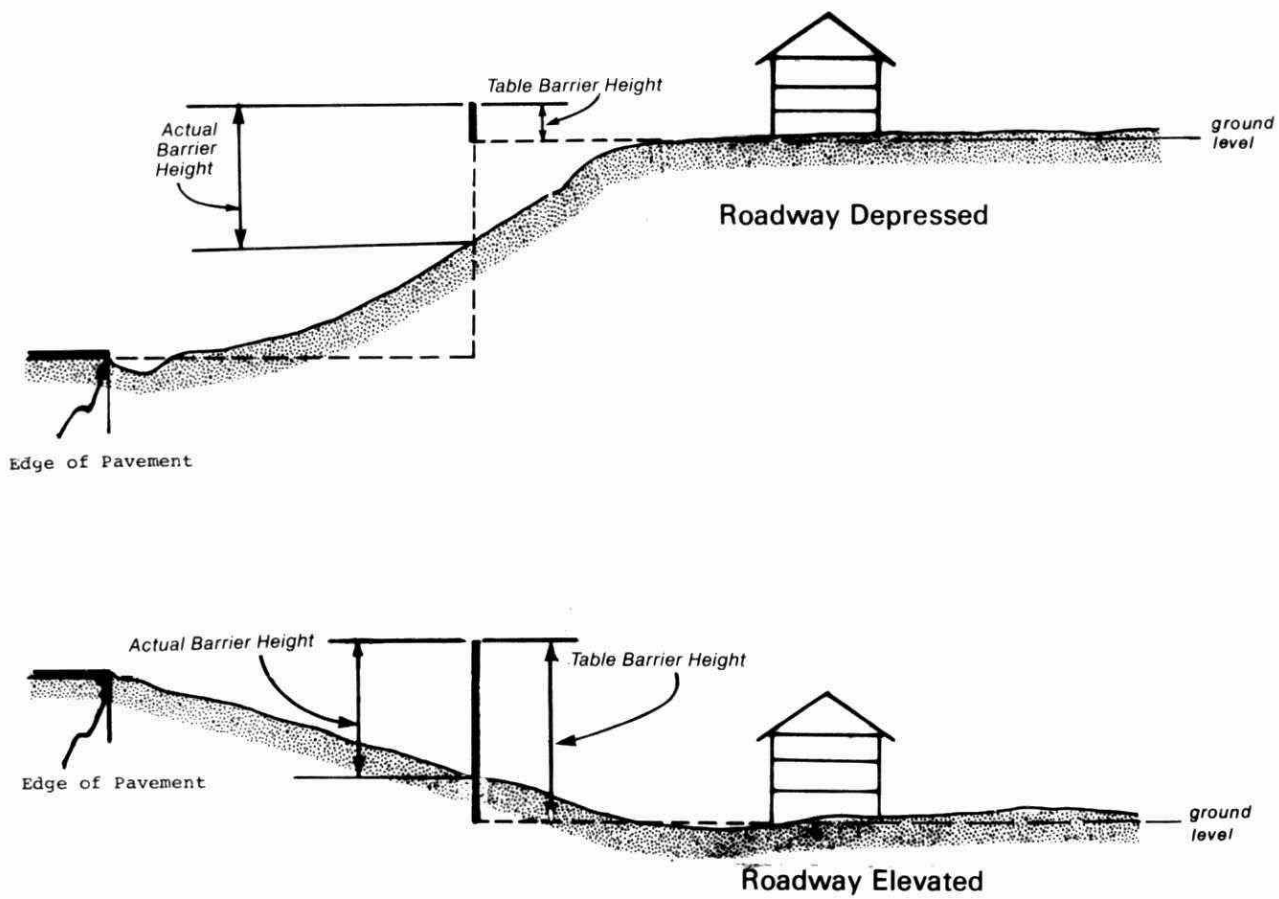


Figure 3.9 — Geometry assumed for barrier calculation.

Step 5: Determine the distance to the first row of normal housing. The value used should be the nearest Table Value to the Distance used in the Red Flagging. No interpolation of Distance is possible in the Barrier Tables. Enter the value of Distance onto the Barrier Tables data sheet and find the column corresponding the Table Value of Distance on the relevant Barrier Table.

Step 6: Determine the Road Elevation (in feet), this being the vertical distance between the roadway surface and the finished grade level in the subdivision corresponding to ground level at the nearest row of normal housing. If the Road Elevation does not exactly correspond to the Table Values then the nearest Table Value should be used. Note that depressed roadways should be given a minus sign for the elevation. Enter the Road Elevation values onto the Barrier Tables data sheet. Find the row corresponding to the Table Value of Road Elevation and move across to the column corresponding the Table Value of Distance.

Step 7: Copy out the nine values of information in the box corresponding to the Table Values of Distance and Roadway Elevation onto the Barrier Table data sheet. The meaning of the various symbols in the Barrier Tables is discussed in Section 3.2.1.

Step 8: For the three Table Values of Distance 110, 170 and 250 feet respectively, X's may well be found in some, or all, of the relevant squares of the box copied out under Step 7. In this case a change in the site layout and density may well be required. The same site layout change may also be required for other distances if a simple numeral value between 1 and 15 is not found in some, or all, of the relevant squares in the nine square box. The reasons for this will be discussed later, but an extra 215 feet may be needed for a building barrier placed between the property line and the first row of normal housing (see Fig. 3.10 and 3.11).

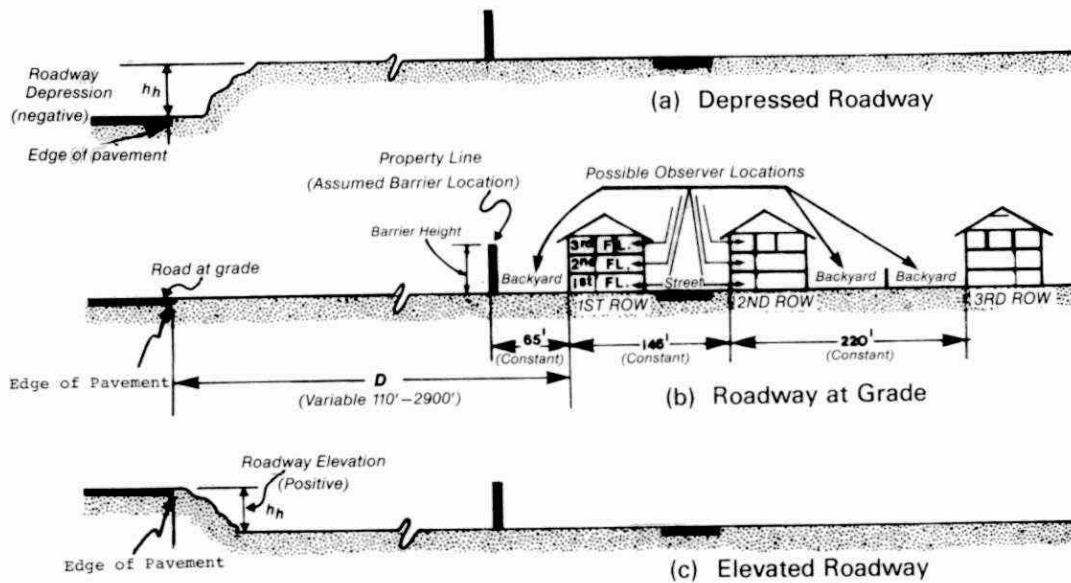
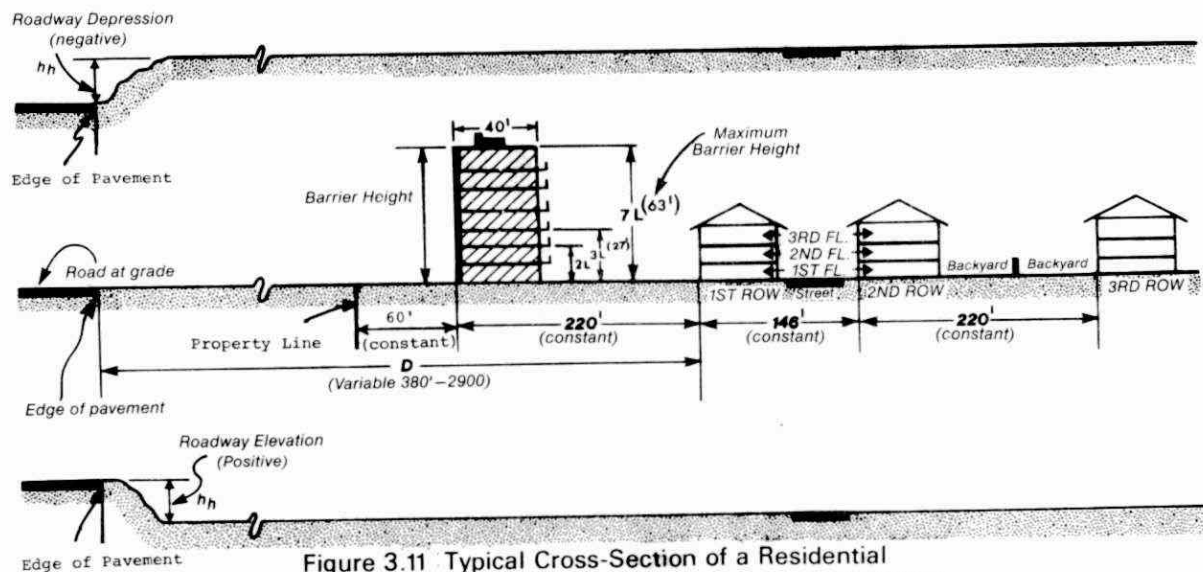


Figure 3.10 Typical Cross-Section of a Residential Subdivision protected by a barrier



To obtain information on this new situation, re-enter the Data Value of Distance from Step 5 onto the Barrier Table data sheet and add 215 ft. The nearest Table Value of Distance larger than the increased Data Value of Distance should then be entered on the Barrier Table data sheet. This will ensure sufficient space for the site layout change. Move across from the nine square box copied out in Step 8 to the relevant box for the new Table Value of Distance.

Step 9: Copy the values in the new square box onto the Barrier Tables data sheet.

### 3.2.1 Definitions of Symbols Used in the Barrier Tables

<u>Symbol</u>	<u>Description</u>
" - "	There is no vehicle noise problem in this row of normal housing. Noise control measures will not be required for this row of housing, but may be required for rows closer to the roadway.
1,2,3,4,5, 6,7,8,9,10, 11,12,13,14,15	The particular row and floor is protected by a noise barrier whose height in feet above the ground level on the subdivision is given by the numeral in the appropriate square. Fig. 3.9 shows the definition of barrier height used. The noise barrier can be a berm, wall, solid fence or any combination of these so long as it has a minimum density of 4 lb./ft. <sup>2</sup> and has no holes or gaps. The typical site layout assumed to arrive at these barrier heights is shown in Fig. 3.10.
2L, 2½L, 3L, 3½L, 4L, 4½L, 5L, 5½L, 6L, 6½L, 7L	The particular row and floor that can be protected by a barrier building whose number of levels (L) or floors above ground level on the subdivision is given by the symbol in the appropriate square. Each floor or level is assumed to be 9 ft., with ½L for split level homes being taken as 4½ ft. Noise levels inside the barrier building should be suitably reduced using either

<u>Symbol</u>	<u>Description</u>
	blank walls or suitable (perhaps double and/or non-openable) glazing facing the roadway plus adequate ventilation from the other side of the building, forced air ventilation or air conditioning, to avoid the necessity of opening windows during the summer months.
	The typical site layout assumed to calculate these barrier building heights is shown in Fig. 3.11.
" X "	Case (i) for distances of 110,170 and 250 feet:
	The particular housing row and floor cannot be adequately protected by a barrier of reasonable height. A site layout and density change is necessary and a barrier building used as the noise control measure. Refer to Step 8 on the Barrier Table data sheet. When roadway is elevated, direct calculation may be required instead of using Table indication.
" X "	Case (ii) for distances 380 feet and greater.



### Description

The particular building row and floor which cannot be adequately protected by either a barrier of reasonable height or barrier building less than 7 floors high should be acoustically treated or the site not used for residential development at this distance from the roadway. Greater distances could also be considered restarting the procedure from Step 5 on the Barrier Table using a distance which will not result in the "X" symbol in the Table.

#### 3.2.2. Example of the Use of the Barrier Table

The following data were obtained (This example closely corresponds to Example in Section 3.1.8)

Speed	55 mph
Truck Percentage	15%
Roadway Grade	2%
Traffic Volume (10 years hence)	27,000 veh/day
Distance	300 ft.
Roadway Elevation	+12 ft. (elevated above sub- division grade)

Note: Reference (3) has been checked to ensure that level of service C is not less than 27,000 veh/day for the roadway under consideration. If less, use the operating speed corresponding to level C. The completed Barrier Tables data sheet follows.

### Example 1

Step 1: Speed =

Step 2: Truck Percent =

Step 3: Roadway Grade =

Data Value	Table Value Used
55 m.p.h.	60 m.p.h.
15 %	20 %
2 %	0-3 %

Step 4: Table to be used is

Number	16 - 7
--------	--------

(a) from Fig. 3.7      from Fig. 3.8

(b) Traffic Volume =

Step 5: Distance =

Step 6: Road Elevation =

Data Value	Table Value Used
27,000 veh/day	28,000 veh/day
300 ft.	250 ft.
12 ft.	10 ft.

use minus sign for depressed road

Step 7:

		1st Row	2nd	3rd
Receiver Height (Floors)	1st	15	X	X
	2nd	X	X	X
	3rd	X	X	X

See 3.2.1 for meaning of symbols 15 and X.

Step 8: Data Value of Distance =

300 ft.	Table Value Used
+ 215 ft.	
515 ft.	570 ft.

∴ Increased Data Value of Distance =

		1st Row	2nd	3rd
Receiver Height (Floors)	1st	11	15	-
	2nd	2½L	2½L	-
	3rd	3L	3L	-

Barrier and no set back reqd.  
Barrier Block and set back necessary.

Noise problem may be resolved by increasing set back to accomodate barrier block between roadway and normal rows of houses.

A 2½L or 3L barrier block height is indicated for 2 storey or 3 storey developments respectively.

Fig.3.6.1 BARRIER TABLES DATA SHEET

### 3.2 DISCUSSION ON THE PHILOSOPHY AND USE OF DATA FROM THE BARRIER TABLES

So far the use of the Barrier Tables has been presented in the form of an automatic procedure with very little rationale being presented to support this procedure. This Section is intended to give a description of the basic philosophy of the Barrier Tables and, hopefully, at the same time familiarize the user with the information which can be derived from using them.

The first consideration on any site, adjacent to a roadway, which suffers a noise impact is whether, or not, a simple barrier (such as a berm, wall, solid fence or combination of these) can be built to sufficient height to protect the highest floor level in the first normal housing rows of the subdivision. In the example above, Step 7 on the Barrier Tables data sheet shows that in the first row only the first floor can be protected by a barrier 15 feet high. Unfortunately, no barrier of sufficient height can be erected to protect the 2nd and 3rd rows, even if they are single floor residences. For this particular case, no noise control measures are practicable with the present site layout and density. The site layout must be changed and a barrier building inserted between the normal housing and the highway.

Before this is investigated, however, it is worth considering the position when a simple barrier can protect the 1st, 2nd and 3rd rows up to say the 1st floor level. In this case the developer or site planner has two alternatives;

- i) to erect single floor homes  
(i.e. bungalows) or
- ii) erect homes with two, or more, floors but air condition them.

Alternative i) is fairly straightforward. Alternative ii), however, may need some explanation. In this situation the barrier is protecting the outdoor environment and the 1st floor only. The indoor environment in the upper floors is not protected by the barrier.

However, if windows can be left closed then they will provide sufficient attenuation to lower indoor sound levels to acceptable values. Thus, if air conditioning is provided, the windows will remain closed and will ensure that the indoor noise levels are acceptable if the windows are suitably designed. For values of dBA excess ( $L_E$ ) obtained from the Red Flagging procedure less than 10 dBA, normal single pane, thermopane or sliding storm windows will ensure acceptable indoor noise levels. For excesses ( $L_E$ ) greater than 10 dBA, however, special glazing will, of course, only be required in those floors where adequate protection is not provided by the barrier, as indicated by the Barrier Tables.

If different barrier heights are indicated for a particular floor in the 1st, 2nd and 3rd rows, then the greatest height should be used. It may also be possible that, due to distance attenuation of sound, a certain barrier height will protect say single floor homes in the first row and two floor homes in the second and third rows. The building heights on the subdivision can then follow this general pattern.

For elevated highways, barrier heights are calculated relative to grade level on the subdivision under consideration. It may be possible to construct a barrier of smaller height at the same level as the roadway on the road shoulder. In this case, an "X" for the simple barrier case (not for a

building barrier which must obviously be at the subdivision grade) only indicates that a barrier 15 ft. above subdivision level is not adequate to sufficiently attenuate noise levels. If the possibility exists to construct a barrier at the roadway grade level (that is on the roadway shoulder) then the necessary barrier height should be calculated following the procedures given in Section 8.

Returning now to the Example given above, since Step 7 of the Barrier Tables data sheet has indicated that no practical simple barrier can adequately protect the 2nd and 3rd rows, a site layout (and perhaps housing density) change is required. The noise control measure would then be a barrier building ( a row of townhouses or apartment blocks) inserted between the roadway and the 1st row or normal housing. The extra distance required for this extra row is some 215 feet. This distance can be checked by reference to Fig. 3.10 and 3.11. These Figures will also demonstrate the change in site layout under consideration. Step 8 on the Barrier Tables data sheet indicates the noise control measures required for this situation. If the developer wishes to build 2 floor homes, then he will need a split level ( $2\frac{1}{2}$  floor) row of townhouses. The total height of these townhouses will be  $22\frac{1}{2}$  feet using 9 ft. per whole level and  $4\frac{1}{2}$  feet for a half level. The townhouses need not necessarily be  $2\frac{1}{2}$  levels as long as they are at least  $22\frac{1}{2}$  feet in height above ground level on the subdivision Step 8 also indicates that 3 floor homes can be protected by a 3 floor (or 27 ft. high) row of townhouses.

A further point of interest from the Example above is that, because of distance attenuation, no protection is required for the third row as indicated by Step 8. Noise levels already being reduced down to acceptable levels.

Also the Table seems to indicate that a simple 15 foot high barrier could protect single floor homes on the site. However, at this stage of the investigation, the simple barrier alternative has already been examined in Step 7 and rejected. Step 8 should thus be ignored. In the event that only simple numerals appear in the relevant squares of the nine square box copied out in Step 8, then these simple numerals should be read as being a minimum barrier building height or 2L or two floors giving a barrier building 18 feet in height.

It should always be remembered when using the Tables that numerals 1 to 15 inclusive refer to a simple barrier and the site layout of Fig. 3.10; while symbols 2L to 7L inclusive refer only to a barrier building and the site layout of Fig. 3.11.

Although basic definitions of a simple barrier and barrier building have already been provided in Section 3.2.1, further explanation is necessary and is given here. First, some general comments. All the barrier heights given in the Barrier Tables are calculated assuming a continuous, infinite barrier. This is clearly not possible in practical terms. Gaps in the barriers should hardly be permitted at all for simple barriers and restricted as much as possible for barrier buildings. To make up for the difficulty of constructing only finite barriers, it is also necessary to continue the barrier along those edges of the site which are closely at right angles to the roadway. This will ensure that dwellings close to the edges of the subdivision are protected by this barrier running away from the roadway. A second (and preferable) approach is to continue the same noise control measure along adjacent subdivisions, making a unified approach to the noise impact of roadways possible. Planners handling large land tracts should always apply a

unified approach to noise control measures near roadways, in this way, wherever possible. The effects of unavoidable breaks in the barrier due to intersecting smaller roads should be minimized by continuing the barrier round the intersection and parallel to the intersecting road.

As previously stated, the simple barrier can be a berm, wall, solid fence or any combination of these, so long as it has no holes or gaps, and has a density of, at least, 4 lb/ft<sup>2</sup> and a height, above the subdivision ground level, at least equal to the value derived from the Barrier Tables. Structural and maintenance design considerations may well override these minimum acoustical requirements.

The barrier building can be a (near) continuous row of townhouses, apartment blocks or stacked townhouses having a height (or number of levels) above the subdivision ground level at least equal to the value derived from Barrier Tables. Gaps in the barrier building row necessary for aesthetic, safety or access purposes should be minimized and possibly restricted to the form of covered tunnels between adjacent units (Extra rooms being provided over the gaps to form the tunnel ceiling). There should (effectively) be no outdoor recreational space between the roadway and the barrier building, this space being used only for road access and parking or other noise insensitive use. In this way all recreational space will be behind the barrier row and thus be protected from noise.

The indoor spaces of the barrier building should be protected from noise by suitable design of the building facade facing the roadway. This facade could be a blank wall, which might well, however, be thought unacceptable for aesthetic and indoor lighting reasons. If glazing is provided,

it should attenuate sound sufficiently to restrict indoor sound levels to acceptable values. Either special ventilation through the face of the barrier building away from the roadway, forced air ventilation or air conditioning should be provided in the barrier building. (See Appendix B)

Further information on site layout and the institution of noise control measures on a site can be found in Section 7. The Barrier Tables, this discussion and Section 7 together, form a means of providing basic concepts of noise control within a subdivision close to a roadway. Final architectural and acoustical design may well be needed to bring the project to its final design stage. This final design should be within the general concept and philosophy supplied by these Tables.

A bibliography is also provided later on for reader reference on noise control measures and site planning. (See p.228)

#### 4. LIMITATIONS OF THE TABLES

The use of noise control measures such as acoustical barriers and site layout offer the most practicable and, in many situations, the only methods of sufficiently reducing the noise levels on residential developments in the proximity of roadways. The following are, however, the inherent limitations that must be considered when utilizing the Sound Barrier Tables:

##### 4.1 EXTRANEIOUS NOISE SOURCES

It must be realized that even if barrier performance is "accurately" predicted and planned, the resulting sound level at a receiver location may not necessarily be reduced to the recommended sound level limit due to the presence of



other secondary, but still important, noise sources which were not properly accounted for or taken into consideration.

#### 4.2 EXTRANEEOUS REFLECTIONS

The presence of other tall or large structures in the vicinity of a residential development may negate the effectiveness of a planned sound barrier designed for roadway noise. This situation may develop if reflecting surfaces exist on either side of the barrier.<sup>(6)</sup> If sound reflections cannot be avoided, the services of a competent acoustical consultant may be required to minimize the effect.

#### 4.3 ATMOSPHERIC CONDITIONS

The presence of certain atmospheric conditions such as wind, temperature, humidity and air turbulence may reduce the effectiveness of the barrier. However, these conditions, which are difficult to both predict and allow for in calculations are generally of a limited nature as to duration and effect especially at closer distances to the roadway. Therefore, in the absence of systematic data on these conditions, the effects of atmospheric conditions need not be considered.

#### 4.4 ROADWAYS NOT AT GRADE

The Tables are based on the assumption that the ground is flat from the receiver (on grade) to the property boundary and that the change in elevation between a receiver and the roadway is abrupt rather than gradual in order to realize the benefits of a shielded roadway in a cut. See Figure 3.9. (For X values less than 110 feet, each case must be individually examined since barrier may well be placed on extended road shoulder).

#### 4.5 REDUCED PERFORMANCE

To be effective, a straight barrier should be continuous and extend beyond the line-of-sight from all possible receiver locations on a subdivision.

For the purpose of these Tables, the required sound attenuation included in the computer program to yield the minimum required height of a barrier, assumed an infinitely long barrier. However, practical barriers, being of finite length, may have much reduced performance. When considering short length barriers, sound waves diffracting around the ends will reduce the overall performance at most locations seemingly protected by the barrier.<sup>(7)</sup>

As a general rule of thumb, it is preferable to extend the barrier, if possible, to a total length of four times the distance between the barrier and the furthest receiver location under consideration of the site. Furthermore, the barrier may be turned at the ends to improve performance. Discussion of barrier design, however, is not within the contemplated scope of this work.<sup>(8)</sup> (See Section 7)

The barrier may also have to be interrupted because of road access requirements and fire control regulations (especially for rows of townhouses). Therefore, the calculated acoustical performance of the barrier may be reduced depending on the situation. This limitation is particularly critical in barrier buildings where the incoming sound waves due to the roadway noise emissions are often reflected or diffracted as well as following the direct path through any gap between buildings, thereby deteriorating the sound environment in the area (acoustic shadow zone) behind the barrier. Where possible, the gap should form a tunnel or passageway that can be closed by doors or, alternatively, the tunnel wall surfaces can be treated for maximum sound absorption.

#### 4.6 ACCURACY OF THE DATA

At this point it should be repeated that the distances and traffic volumes in the Tables were allowed to vary in such a manner as to increase, or decrease, the sound levels by approximately 2dB (range 1 - 3 dB) which is considered to be a reasonable and practical resolution.

The accuracy of the calculated result is dependent on the accuracy of:

- i) the noise level prediction model;
- ii) the barrier evaluation model;
- iii) the accuracy in projecting future traffic volumes.

Due to this complicated situation and other uncertainties, it may be difficult to estimate the overall accuracy of the entire prediction procedure. It is believed however, that an accuracy of  $\pm 5$ dB, may be achieved if the Tables are correctly used.

Improved resolution may be achieved, however, by direct calculation using the equations provided in Section 8. The entire procedure can be adequately handled by the programable calculators presently available.

The prediction models are based on one frequency only, 500 Hz. In situations where the effect of reflections, or where noise is a highly sensitive issue, requires analysis at other frequencies the accuracy of the barrier and propagation models used here may not be adequate. The Ministry of the Environment should be consulted on these problems.

CASE STUDYApproval of A Draft Plan of Subdivision

This case study summarizes the various processes leading to the approval of the proposed residential subdivision with respect to traffic noise.

Location

The proposed site is part of Lot 7, Concession 2, E.H.S., City of Brampton. The area of the site is approximately 38 acres of which 850 feet front on Heart Lake Road. Ministry of Housing File No. 21T-22805.

Particulars of the Site

The site was planned for a mixed density residential development represented by 126 semi-detached dwelling units (providing 252 dwelling units), and by three blocks of street townhouse dwellings comprising a total of 65 dwelling units. Figure 1 illustrates the site plan layout and the proximity to Heart Lake Road.

Background

At the November 17th, 1975 meeting of the Planning Committee of the City of Brampton, a preliminary report from the Planning Department was considered and it was recommended that the draft plan be released for processing. The planning staff report outlined several matters to be considered with the result that a further revision to the draft plan has been presented for consideration. The specific comment on noise was that the development

DRAFT PLAN OF SUBDIVISION OF  
PART OF LOT 8, CONCESSION 2 EAST OF HURONTARIO STREET  
CITY OF BRAMPTON  
REGIONAL MUNICIPALITY OF PEEL

Scale 1" = 30'

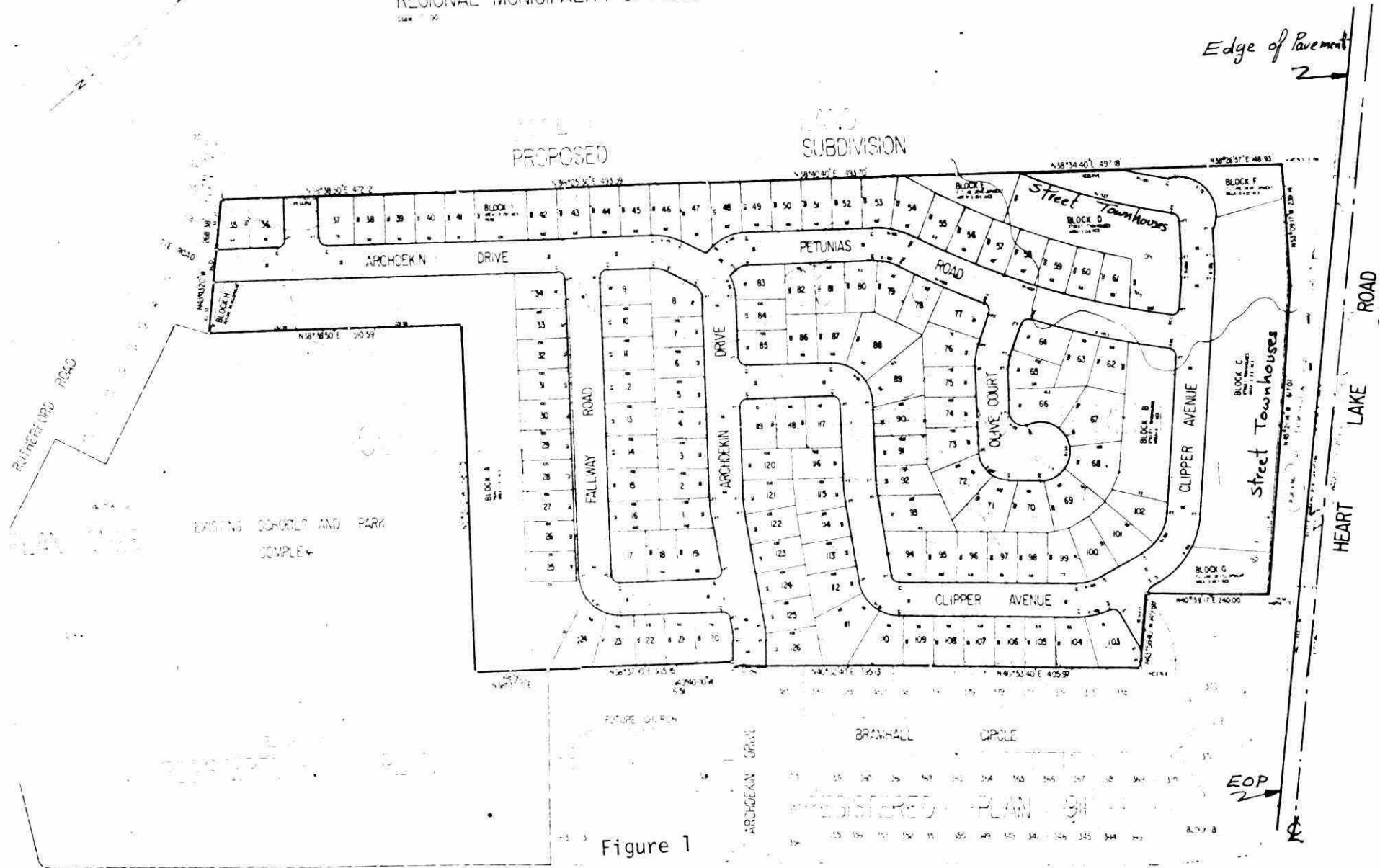


Figure 1

of the lands adjacent to Heart Lake Road will have to be undertaken in recognition of the potential noise pollution from highway traffic (Heart Lake Road). It was also recommended that the zoning by-law should stipulate the need for an additional depth to the rear yard of approximately 50 feet.

It appears that the Planning Department of the City of Brampton was conscious about the potential noise problem on this site due to their prior involvement with the analysis of noise on another subdivision nearby (Registered Plan No. 911). The Ministry of Transportation and Communications had indicated that the estimated 1990 L<sub>10</sub> noise level would be approximately 70 dBA due to future traffic on Heart Lake Road.

The acoustical consultant report dealing with the nearby subdivision confirmed that if certain noise control measures are taken, both the outdoor and indoor acoustical environments will make the houses highly acceptable. The measures included house orientation for indoor and outdoor living environment, building insulation (the use of heavier wall types and double glazing) and acoustical screening as an added measure by means of earth berms and the building structure itself.

Figures 2,3 and 4 illustrate the concepts of noise control already planned for the nearby subdivision which were also sought for the site under consideration.

#### The Process Leading to Approval of the Proposed Development

During February 1976 the draft plan was circulated to the N.P.C.S. for comments.

Our investigation led to the following conclusions:

- a. The predicted sound levels exceeded our recommended sound level limits by approximately 11 dB for the first row of dwelling units.
- b. Inspection of the submitted draft plan (site plan layout) indicated that vehicular traffic noise could be controlled on the entire site, i.e., it is quite feasible to incorporate alternative noise control measures to reduce the predicted noise levels down to the recommended criteria.

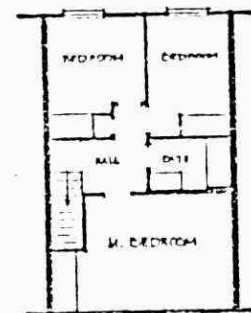
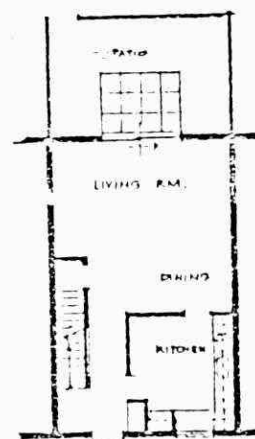
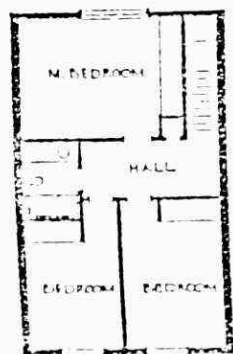
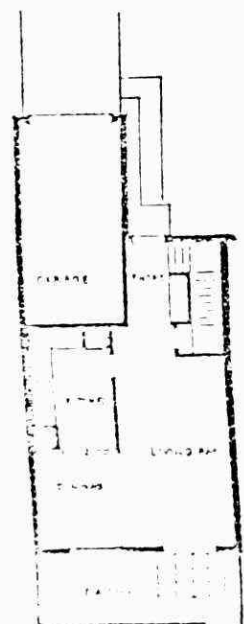
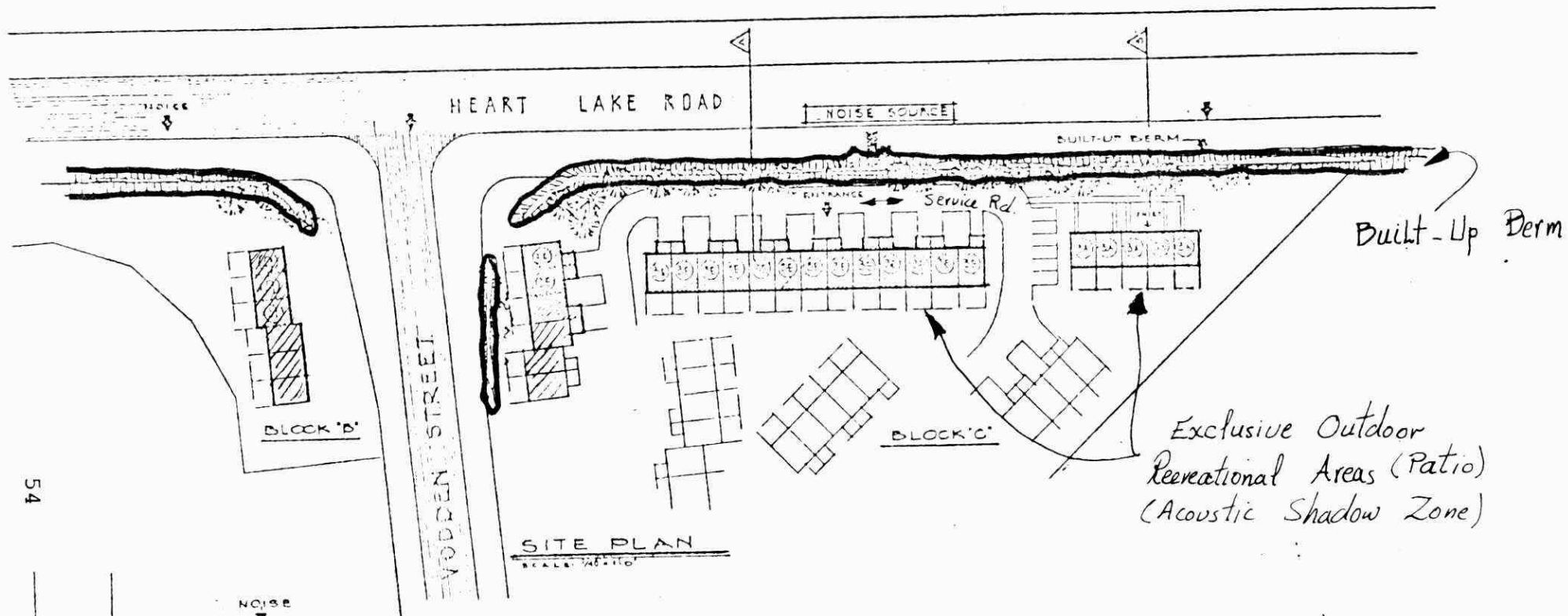
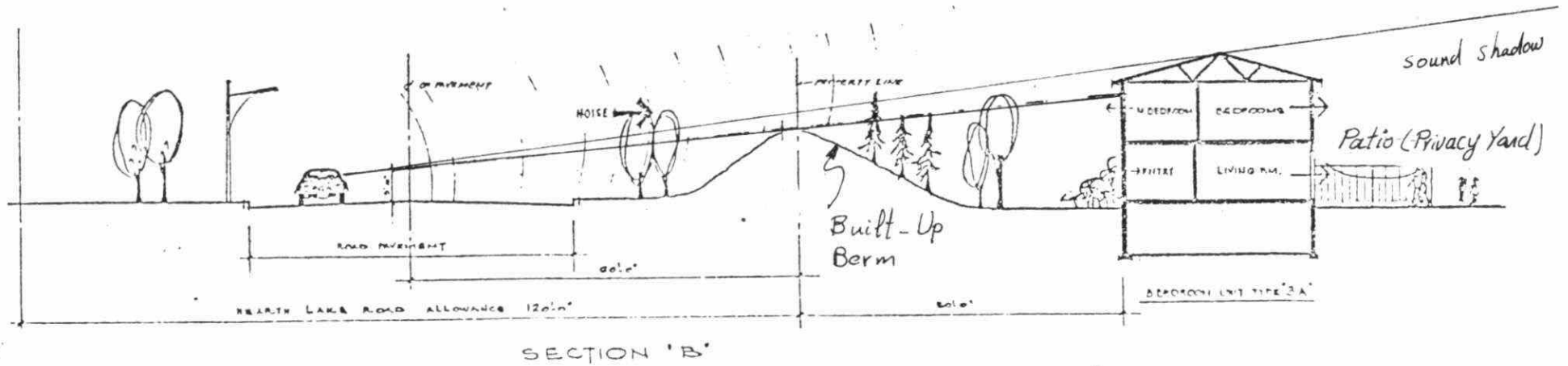
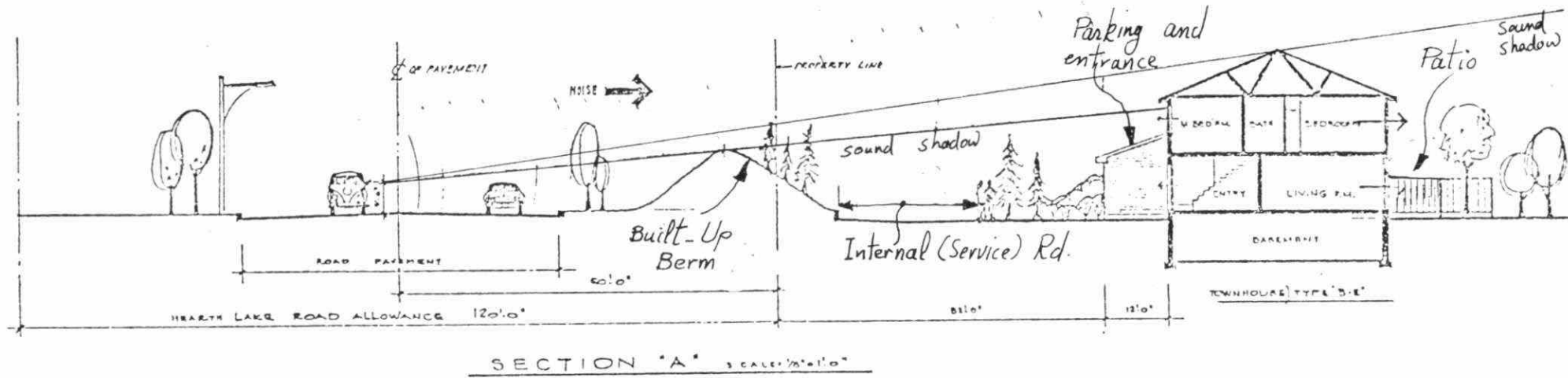


Figure 2



Figure 3







## Figure 4

Therefore, the subject site was recommended for draft approval with appropriate conditions, as follows, to ensure that the final result is an acceptable sound environment:

"Noise Abatement measures shall be incorporated into the site plan layout and construction of the townhouses adjacent to Heart Lake Road in order to form the necessary acoustical envelope. The noise abatement measures shall be effective in reducing the noise impacting the outdoor recreational areas as well as the noise-sensitive indoor spaces in accordance with the guidelines on land use planning with respect to noise recommended by the Noise Pollution Control Section of the Ministry of the Environment prior to the issuance of building permits".

The draft plan received approval subject to conditions including those dealing with traffic noise. The Ministers conditions applying to the approval of the final plan for registration with respect to noise only are as follows:

"That prior to the registration of the plan, noise abatement measures shall be incorporated in to the site plan layout and construction of the townhouses adjacent to Heart Lake Road to the satisfaction of the Ministry of the Environment. In this regard the subdivider's agreement shall contain provisions, in wording acceptable to the Ministry of the Environment, whereby, prior to the issuance of building permits for the site, building and site plans shall be submitted to the Ministry of the Environment for approval."

Following this step, the subdivider's agreement was prepared by the concerned parties which contained a clause (no. 55 on page 29) to ensure appropriate implementation of the noise concerns at the final stage; building permit stage.

The subdivider's agreement was inspected by staff of the N.P.C.S. and found it to be satisfactory. The specific Ministry of Housing conditions on noise were released, thus allowing the draft plan to proceed for final approval and registration. A copy of the relevant clause on noise in the subdivider's agreement is enclosed with this case study.

Finally, it should be noted that the developer has already submitted a set of drawings to the NPCS for final review before applying for the building permit. The plans are still under investigation.

this

29th day of March 1976

APPENDIX

B E T W E E N :

L.D.C.M. INVESTMENTS LIMITED

hereinafter called the 'Owner'

OF THE FIRST PART

A N D

THE CORPORATION OF THE CITY OF BRAMPTON

hereinafter called the 'City'

OF THE SECOND PART

A N D

THE REGIONAL MUNICIPALITY OF PEEL

hereinafter called the 'Region'

OF THE THIRD PART

A N D

MILFORD FRANCIS FENWICK,

VICTORIA WOOD DEVELOPMENT CORPORATION INC.,

THE TORONTO-DOMINION BANK,

hereinafter called the 'Mortgagees'

OF THE FOURTH PART

lands in accordance with the proposed plan of subdivision as draft approved shown as Schedule "B" attached hereto, herein- after referred to as "the plan"; Minister of Housing  
File Number 21T-22805

AND WHEREAS the City agrees that it will recom- mend to the proper authority the release of the plan of sub- division herein for registration subject to the terms and conditions of this agreement and the conditions of draft plan approval.

NOW THEREFORE THIS AGREEMENT WITNESSETH that in consideration of the covenants hereinafter contained and in consideration of the City approving and recommending to the appropriate authorities the approval of the plan for regis- tration, the parties hereto agree each with the other as follows:

#### ENGINEERING, BUILDING AND LANDSCAPING REQUIREMENTS

1. For the purposes of this agreement, "Municipal  
Muni- Engineer" shall mean with respect to all sanitary sewer and  
cipal water services and regional roads and storm drainage on  
Engineer regional roads and any other regional matter the Commissioner  
of Public Works for the Regional Municipality of Peel and  
with respect to all other matters contained in this agreement  
shall mean the City Engineer of the City of Brampton.

2. For the purposes of this agreement, "the works"  
"Works" shall mean all servicing and landscaping required to be done  
by the Owner under the terms of this agreement and without  
limiting the generality of the foregoing, the works shall  
include sanitary sewers and connections, storm sewers and  
connections, watermains 60 ater service connections, road-

to MTC

limit of Heart Lake Road abutting Blocks C, G and F on the draft plan and abutting Blocks D, E and F on the proposed plan which is annexed hereto as Schedule "A" shall be conveyed to the Ministry of Transportation and Communications and an executed deed for the said one-foot (1'0") reserve shall be deposited with the Ministry prior to registration of the plan.

53.

Blocks  
to be  
devel-  
oped  
only  
with  
adja-  
cent  
lands

The Owner agrees that Blocks D, E, F, G and H on the draft plan now respectively C, B, D, F and I on the proposed plan which is annexed hereto as Schedule "B" shall not be developed except in conjunction with adjacent lands and specifically Blocks C, B and D shall only be developed in conjunction with the adjacent lands lying to the north of the northerly boundary of this subdivision and Block F shall only be developed in conjunction with the lands lying south-easterly from Block F and Block I shall only be developed in conjunction with the lands lying south-westerly of Block I.

54.

Report  
on run-  
off for  
MTC

The Owner agrees that a drainage report outlining the developer's treatment of the calculated run-off related to the plan shall be submitted to the Ministry of Transportation and Communications for approval prior to registration of the plan.

55.

Noise  
abate-  
ment  
require-  
ments  
of MOE

The Owner agrees that noise abatement measures shall be incorporated into the site plan lay-out and construction of the townhouses adjacent to Heart Lake Road and that, prior to the issuance of any building permits, building and site plans shall be submitted for the approval of the Ministry of the Environment and no building permits shall be issued for the said townhouses until the City has been advised in writing of the approval of the Ministry.

The covenants, agreements, conditions and undertakings herein contained on the part of the Owner shall run with the lands and shall be binding upon it and upon its successors and assigns and shall be appurtenant to the adjoining highway in the ownership of the City of Brampton and/or the Region of Peel.

IN WITNESS WHEREOF THE PARTIES HERETO have hereunto affixed their corporate seals attested by the hands of their proper officers duly authorized in that behalf.

SIGNED, SEALED AND DELIVERED ) L.D.C.M. INVESTMENTS LIMITED

In the Presence of

) Per;

)

) Per;

)

) THE CORPORATION OF THE CITY OF BRAMPTON

) Per;

)

) Per;

)

) THE REGIONAL MUNICIPALITY OF PEEL

) Per;

)

) Per;

)

) Milford Francis Fenwick

)

) VICTORIA WOOD DEVELOPMENT CORPORATION

) Per;

)

)

) Per;

)

) THE TORONTO-DOMINION BANK

) Per;

)

) VICE-PRESIDENT AND GENERAL MANAGER

)

)

AUTHORIZATION BY LAW  
NUMBER 75-76  
PASSED BY THE REGIONAL  
COUNCIL ON THE 8th  
DAY OF April 1976.

2. c. *[Signature]*

E 8831







# RED FLAGGING TABLES INDEX

Excess Sound Level in dBA over Recommended\* Outdoor Sound Level Limits for Various Traffic and Roadway Parameter

Table No.	Combination of Traffic Parameters		
	Speed (mph)	% Truck	% Grade
1	40	10	0 to 3
2	40	10	4 to 6
3	40	10	7 +
4	40	20	0 to 3
5	40	20	4 to 6
6	40	20	7 +
7	50	10	0 to 3
8	50	10	4 to 6
9	50	10	7 +
10	50	20	0 to 3
11	50	20	4 to 6
12	50	20	7 +
13	60	10	0 to 3
14	60	10	4 to 6
15	60	10	7 +
16	60	20	0 to 3
17	60	20	4 to 6
18	60	20	7 +

\* For Recommended Limits, see Section 8.2 and Appendix B.



TABLE: 1

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 40 (M.P.H.) % TRUCK: 10% % GRADE: 0-3%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800									
5,600									
8,400	2	-							
13,000	4	1	-						
19,000	6	3	-						
28,000	7	5	3	1	-				
43,000	9	7	5	3	1	-			
64,000	12	10	8	6	4	2	-		
96,000	15	13	11	9	6	4	2	-	
140,000	17	15	13	11	9	7	5	3	1
220,000	20	18	16	14	12	10	8	6	4

TABLE: 2

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 40 (M.P.H.) % TRUCK: 10% % GRADE: 4-6%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800									
5,600	1								
8,400	2	-							
13,000	4	2	-						
19,000	6	4	1	-					
28,000	8	6	4	2	-				
43,000	10	8	6	4	2	-			
64,000	13	11	9	7	5	3	1	-	
96,000	16	14	12	9	7	5	3	1	-
140,000	18	16	14	12	10	8	6	4	2
220,000	21	19	17	15	13	11	9	6	4

TABLE: 3

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 40 (M.P.H.)      % TRUCK: 10%      % GRADE: 7+%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800									
5,600	1	-							
8,400	3	-							
13,000	5	2	-						
19,000	7	4	2	-					
28,000	9	7	5	3	1	-			
43,000	11	9	7	5	3	1	-		
64,000	14	12	10	8	6	4	2	-	
96,000	16	14	12	10	8	6	4	2	-
140,000	19	17	15	13	11	9	7	5	3
220,000	22	19	17	15	13	11	9	7	5

TABLE: 4

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 40 (M.P.H.)      % TRUCK: 20%      % GRADE: 0-3%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800									
5,600	1	-							
8,400	2	-							
13,000	4	2	-						
19,000	6	4	1	-					
28,000	8	6	4	2	-				
43,000	10	8	6	4	2	-			
64,000	13	11	9	7	5	3	1	-	
96,000	16	14	12	9	7	5	3	1	-
140,000	18	16	14	12	10	8	6	4	2
220,000	21	19	17	15	13	11	9	6	4

TABLE: 5

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 40 (M.P.H.)      % TRUCK: 20%      % GRADE: 4-6%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800									
5,600	2	-							
8,400	4	1	-						
13,000	6	3	-						
19,000	7	5	3	-					
28,000	9	7	5	3	-				
43,000	12	10	8	6	4	2	-		
64,000	15	13	11	9	6	4	2	-	
96,000	17	15	13	11	9	7	5	3	-
140,000	20	18	16	14	12	10	8	6	4
220,000	22	20	18	16	14	12	10	8	6

TABLE: 6

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 40 (M.P.H.)      % TRUCK: 20%      % GRADE: 7+%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800	1	-							
5,600	3	-							
8,400	5	2	-						
13,000	7	4	2	-					
19,000	8	6	4	2	-				
28,000	11	9	7	5	3	1	-		
43,000	13	11	9	7	5	3	1	-	
64,000	16	14	12	10	8	6	4	2	-
96,000	18	16	14	12	10	8	6	4	2
140,000	21	19	17	15	13	11	9	7	5
220,000	24	21	19	17	15	13	11	9	7

TABLE: 7

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 50 (M.P.H.)      % TRUCK: 10%      % GRADE: 0-3%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800	1	-							
5,600	2	-							
8,400	4	1	-						
13,000	6	3	-						
19,000	8	5	2	-					
28,000	10	7	4	2	-				
43,000	12	9	7	5	3	1	-		
64,000	14	12	10	8	6	4	1	-	
96,000	16	14	12	10	8	6	4	2	-
140,000	19	17	15	13	11	9	7	5	3
220,000	21	19	17	15	13	11	9	7	5

TABLE: 8

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 50 (M.P.H.)      % TRUCK: 10%      % GRADE: 4-6%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800	1	-							
5,600	3	-							
8,400	5	2	-						
13,000	7	4	1	-					
19,000	8	6	3	1	-				
28,000	10	8	5	3	1	-			
43,000	12	10	8	6	4	2	-		
64,000	15	13	11	9	7	4	2	1	-
96,000	17	15	13	11	9	7	5	3	1
140,000	20	18	16	14	12	10	8	6	4
220,000	22	20	18	16	14	12	10	8	6

TABLE: 9

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 50 (M.P.H.)      % TRUCK: 10%      % GRADE: 7+%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800	2	-							
5,600	4	1	-						
8,400	5	3	-						
13,000	7	4	2	-					
19,000	9	6	4	2	-				
28,000	11	8	6	4	2	-			
43,000	13	11	9	7	5	3	1	-	
64,000	15	13	11	9	7	5	3	1	-
96,000	18	16	14	12	10	8	6	4	2
140,000	21	19	17	14	12	10	8	6	4
220,000	23	21	19	17	15	13	11	9	7

TABLE: 10

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 50 (M.P.H.)      % TRUCK: 20%      % GRADE: 0-3%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800	1	-							
5,600	3	-							
8,400	5	2	-						
13,000	7	4	1	-					
19,000	8	6	3	1	-				
28,000	10	8	5	3	1	-			
43,000	12	10	8	6	4	2	-		
64,000	15	13	11	9	7	4	2	-	
96,000	17	15	13	11	9	7	5	3	1
140,000	20	18	16	14	12	10	8	6	4
220,000	22	20	18	16	14	12	10	8	6



TABLE: 11

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 50

(M.P.H.)

% TRUCK: 20%

% GRADE: 4-6%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500									
3,800	2	-							
5,600	4	1	-						
8,400	6	3	-						
13,000	8	5	2	-					
19,000	10	7	4	2	-				
28,000	12	9	7	5	3	1	-		
43,000	14	12	10	8	6	4	2	-	
64,000	16	14	12	10	8	6	4	2	-
96,000	19	17	15	13	11	9	7	5	3
140,000	21	19	17	15	13	11	9	7	5
220,000	24	22	20	18	16	14	12	10	8

TABLE: 12

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 50

(M.P.H.)

% TRUCK: 20%

% GRADE: 7+%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500	1	-							
3,800	3	-							
5,600	5	2	-						
8,400	7	4	1	-					
13,000	9	6	3	1	-				
19,000	11	8	6	4	2	-			
28,000	13	10	8	6	4	2	-		
43,000	15	13	11	9	7	5	3	1	-
64,000	17	15	13	11	9	7	5	3	1
96,000	20	18	16	14	12	10	8	6	4
140,000	23	21	19	16	14	12	10	8	6
220,000	25	23	21	19	17	15	13	11	9

TABLE: 13

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 60 (M.P.H.) % TRUCK: 10% % GRADE: 0-3%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500	1	-							
3,800	3	-							
5,600	5	2	-						
8,400	6	4	1	-					
13,000	8	5	3	-					
19,000	10	7	5	2	-				
28,000	12	9	6	4	2	-			
43,000	14	11	9	7	5	3	1	-	
64,000	16	13	11	9	7	5	3	1	-
96,000	18	16	14	12	10	8	6	4	2
140,000	20	18	16	14	12	10	8	6	4
220,000	23	21	19	17	15	13	11	9	7

TABLE: 14

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 60 (M.P.H.) % TRUCK: 10% % GRADE: 4-6%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500	2	-							
3,800	4	1	-						
5,600	5	2	-						
8,400	7	4	1	-					
13,000	9	6	3	1	-				
19,000	11	8	5	3	-				
28,000	12	10	7	5	3	1	-		
43,000	14	12	10	8	6	4	2	-	
64,000	16	14	12	10	8	6	4	2	-
96,000	19	17	15	13	11	9	7	5	3
140,000	21	19	17	15	13	11	9	7	5
220,000	24	22	20	18	16	14	12	10	8

TABLE: 15

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 60 (M.P.H.)

% TRUCK: 10%

% GRADE: 7+%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500	2	-							
3,800	4	1	-						
5,600	6	3	-						
8,400	8	5	2	-					
13,000	9	7	4	1	-				
19,000	11	9	6	3	1	-			
28,000	13	10	8	6	4	2	-		
43,000	15	12	10	8	6	4	2	-	
64,000	17	15	13	11	9	7	5	3	1
96,000	20	18	16	14	12	9	7	5	3
140,000	22	20	18	16	14	12	10	8	6
220,000	25	23	21	19	17	15	13	11	9

TABLE: 16

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 60 (M.P.H.)

% TRUCK: 20%

% GRADE: 0-3%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500	2	-							
3,800	4	1	-						
5,600	5	2	-						
8,400	7	4	1	-					
13,000	9	6	3	1	-				
19,000	11	8	5	3	-				
28,000	12	10	7	5	3	1	-		
43,000	14	12	10	8	6	4	2	-	
64,000	16	14	12	10	8	6	4	2	-
96,000	19	17	15	13	11	9	7	5	3
140,000	21	19	17	15	13	11	9	7	5
220,000	24	22	20	18	16	14	12	10	8

TABLE: 17

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 60 (M.P.H.) % TRUCK: 20% % GRADE: 4-6%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500	3	-							
3,800	5	2	-						
5,600	6	4	1	-					
8,400	8	5	3	-					
13,000	10	7	5	2	-				
19,000	12	9	6	4	2	-			
28,000	14	11	9	7	5	3	1	-	
43,000	16	13	11	9	7	5	3	1	-
64,000	18	16	14	12	10	8	6	4	2
96,000	20	18	16	14	12	10	8	6	4
140,000	23	21	19	17	15	13	11	9	7
220,000	25	23	21	19	17	15	13	11	9

TABLE: 18

DBA EXCESS OVER RECOMMENDED DESIGN SOUND  
LEVEL LIMITS FOR TRAFFIC NOISE

SPEED: 60 (M.P.H.) % TRUCK: 20% % GRADE: 7+%

Distance (FT) Flow V.P.D.	110	170	250	380	570	850	1,300	1,900	2,900
2,500	4	1	-						
3,800	5	3	-						
5,600	7	4	2	-					
8,400	9	6	4	1	-				
13,000	11	8	5	3	1	-			
19,000	13	10	7	5	3	1	-		
28,000	15	12	10	8	6	4	2	-	
43,000	17	14	12	10	8	6	4	2	-
64,000	19	17	15	13	11	9	7	5	3
96,000	22	20	18	16	14	11	9	7	5
140,000	24	22	20	18	16	14	12	10	8
220,000	27	25	23	21	19	17	15	13	11

6.

SOUND BARRIER TABLES

## SOUND BARRIER TABLES INDEX

Tables	Speed (mph)	% Truck	% Grade	Volume (Veh/Day)
1-4 through 1-12	40	10	0 to 3	8,400 through 220,000
2-3 " 2-12	40	10	4 to 6	5,600 " 220,000
3-3 " 3-12	40	10	7 +	5,600 " 220,000
4-3 " 4-12	40	20	0 to 3	5,600 " 220,000
5-3 " 5-12	40	20	4 to 6	5,600 " 220,000
6-2 " 6-12	40	20	7 +	3,800 " 220,000
7-2 " 7-12	50	10	0 to 3	3,800 " 220,000
8-2 " 8-12	50	10	4 to 6	3,800 " 220,000
9-2 " 9-12	50	10	7 +	3,800 " 220,000
10-2 " 10-12	50	20	0 to 3	2,500 " 220,000
11-1 " 11-12	50	20	4 to 6	2,500 " 220,000
12-1 " 12-12	50	20	7 +	3,800 " 220,000
13-1 " 13-12	60	10	0 to 3	2,500 " 220,000
14-1 " 14-12	60	10	4 to 6	2,500 " 220,000
15-1 " 15-12	60	10	7 +	2,500 " 220,000
16-1 " 16-12	60	20	0 to 3	2,500 " 220,000
17-1 " 17-12	60	20	4 to 6	2,500 " 220,000
18-1 " 18-12	60	20	7 +	2,500 " 220,000

## SOUND BARRIER TABLES INDEX



TABLE: 1-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	8	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	1	-																									
	2nd	3	-																									
	3rd	7	-																									

VOLUME: 8,400 (VEH./DAY)

SPEED: 40 (M.P.H.)

%TRUCK: 10%

%GRADE: 0 to

VOLUME: 6,400 (VEH/DAY) SPEED: 40 (M.P.H.) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 1-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+15	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+10	1st	X	-	-	14	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+5	1st	14	-	-	12	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
GROUND LEVEL	1st	11	-	-	10	-																						
	2nd	14	-	-	15	-																						
	3rd	X	-	-	X	-																						
-5	1st	8	-	-	8	-																						
	2nd	12	-	-	14	-																						
	3rd	15	-	-	X	-																						
-10	1st	5	-	-	6	-																						
	2nd	9	-	-	12	-																						
	3rd	12	-	-	13	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	-	-	13	-																						
-20	1st	1	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	13	-																						

VOLUME: 13,000 (VEH/DAY) SPEED: 40 (M.P.H.) %TRUCK: 10% %GRADE: 0 to 3



TABLE: 1-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+15	1st	X	X	-	X	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+10	1st	X	X	-	14	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+5	1st	14	X	-	12	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
GROUND LEVEL	1st	11	12	-	10	-																						
	2nd	15	13	-	X	-																						
	3rd	X	15	-	X	-																						
-5	1st	8	8	-	8	-																						
	2nd	12	9	-	14	-																						
	3rd	X	11	-	X	-																						
-10	1st	5	3	-	6	-																						
	2nd	9	5	-	12	-																						
	3rd	13	7	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	-	-	15	-																						
-20	1st	-	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	14	-																						

VOLUME: 19,000 (VEH./DAY)      SPEED: 40 (MPH)      %TRUCK: 10%      %GRADE: 0 to 3

VOLUME 19,000 (VEH./DAY) SPEED 40 (MPH) %TRUCK 10% %GRADE 0 to 3

TABLE: 1-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	-	-	13	-																
	2nd	X	X	-	X	X	-	X	-	-	X	-																
	3rd	X	X	-	X	X	-	X	-	-	X	-																
+15	1st	X	X	-	X	X	-	14	-	-	12	-																
	2nd	X	X	-	X	X	-	X	-	-	X	-																
	3rd	X	X	-	X	X	-	X	-	-	X	-																
+10	1st	X	X	-	14	X	-	12	-	-	11	-																
	2nd	X	X	-	X	X	-	X	-	-	2L	-																
	3rd	X	X	-	X	X	-	X	-	-	3L	-																
+5	1st	14	X	-	12	X	-	11	-	-	10	-																
	2nd	X	X	-	X	X	-	X	-	-	2L	-																
	3rd	X	X	-	X	X	-	X	-	-	2½L	-																
GROUND LEVEL	1st	11	12	-	10	12	-	10	-	-	9	-																
	2nd	15	13	-	X	15	-	X	-	-	2L	-																
	3rd	X	15	-	X	X	-	X	-	-	2½L	-																
-5	1st	8	8	-	8	8	-	9	-	-	9	-																
	2nd	12	9	-	14	11	-	15	-	-	2L	-																
	3rd	X	11	-	X	12	-	X	-	-	2L	-																
-10	1st	5	4	-	7	5	-	7	-	-	8	-																
	2nd	9	5	-	12	8	-	14	-	-	15	-																
	3rd	13	7	-	X	11	-	X	-	-	2L	-																
-15	1st	3	-	-	5	2	-	6	-	-	7	-																
	2nd	6	-	-	10	5	-	13	-	-	14	-																
	3rd	10	3	-	X	8	-	X	-	-	2L	-																
-20	1st	1	-	-	3	2	-	5	-	-	6	-																
	2nd	3	-	-	8	3	-	11	-	-	13	-																
	3rd	7	-	-	14	4	-	X	-	-	2L	-																

VOLUME: 28,000 (VEH./DAY)

SPEED: 40 (MPH)

%TRUCK: 10%

%GRADE: 0 TO

VOLUME 20,000 (VEH./DAY) SPEED 40 (MPH) %TRUCK 10% %GRADE 0 to 3

TABLE: 1-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	X	-	13	3L	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	3½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	4L	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	-	X	X	-	14	X	-	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	-	15	15	-	13	15	-	11	15	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	-	13	15	-	11	14	-	10	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	14	12	-	11	12	-	10	12	-	10	12	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	-	X	15	-	X	X	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	-	X	X	-	X	X	-	2½L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	11	8	-	9	9	-	9	9	-	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	14	9	-	14	12	-	X	14	-	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	-	X	14	-	X	X	-	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	8	4	-	7	6	-	8	7	-	8	8	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	12	5	-	13	8	-	14	11	-	15	13	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	15	7	-	X	9	-	X	15	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	5	1	-	5	2	-	6	4	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	9	1	-	11	5	-	13	8	-	7	11	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	13	1	-	X	8	-	X	12	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	3	1	-	3	1	-	5	-	-	5	4	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	6	1	-	9	1	-	12	5	-	14	9	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	10	1	-	14	4	-	X	10	-	2L	14	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME 43,000 (VEH/DAY) SPEED 40 (M.P.H.) %TRUCK 10% %GRADE: 0 to 3

TABLE: 1-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	2L	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	2L	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	2L	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	15	X	X	13	2½L	3L	11	2½L	2½L	10	14	2L	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	2½L	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	2L	-	-	-	-	-	-	-	-	-
+10	1st	X	15	15	X	X	X	14	X	X	12	2½L	2½L	11	15	2½L	10	13	2L	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2L	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3L	3L	2L	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	13	X	X	11	14	2L	10	13	2L	10	13	2L	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2L	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	2L	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	X	12	13	11	X	X	10	12	13	10	12	13	9	11	2L	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	2L	-	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3½L	2L	-	-	-	-	-	-	-	-	-
-5	1st	15	8	8	14	9	9	10	9	9	9	10	10	9	10	-	9	10	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	15	-	2L	2L	-	-	-	-	-	-	-	-	-	-
	3rd	X	12	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	2½L	-	-	-	-	-	-	-	-	-	-
-10	1st	12	4	3	12	6	5	9	7	6	8	8	7	8	9	-	9	9	-	-	-	-	-	-	-	-	-	-
	2nd	X	6	4	X	9	6	15	11	10	2L	15	11	15	13	-	2L	2L	-	-	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	12	8	X	X	11	2L	2L	2L	2½L	2L	-	2½L	2L	-	-	-	-	-	-	-	-	-	-
-15	1st	10	1	1	10	1	1	7	4	3	8	6	4	7	6	-	8	8	-	-	-	-	-	-	-	-	-	-
	2nd	14	2	1	15	5	2	14	9	5	2L	13	8	15	11	-	2L	15	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	1	X	8	4	X	13	8	2L	2L	2L	2L	2L	-	2½L	2L	-	-	-	-	-	-	-	-	-	-
-20	1st	7	1	1	8	1	1	6	2	-	7	4	1	7	6	-	8	7	-	-	-	-	-	-	-	-	-	-
	2nd	11	1	1	14	2	1	13	6	2	2L	13	9	15	9	-	2L	14	-	-	-	-	-	-	-	-	-	-
	3rd	15	1	1	X	5	1	X	10	4	2L	2L	14	2L	14	-	2½L	2L	-	-	-	-	-	-	-	-	-	-

VOLUME 64,000 (VEH/DAY) SPEED 40 (M.P.H.) %TRUCK 10% %GRADE: 0 to 3

TABLE: 1-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3L	3L	3 $\frac{1}{2}$ L	12	2 $\frac{1}{2}$ L	3L	11	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3L	3L	3 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	3L	3 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	4L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	4L	3L	3L	-						
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	12	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	11	15	2 $\frac{1}{2}$ L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3 $\frac{1}{2}$ L	3L	3L	2 $\frac{1}{2}$ L	3L	3L	2 $\frac{1}{2}$ L	3L	3L	2L	2L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3 $\frac{1}{2}$ L	3L	3L	-						
+10	1st	X	X	X	X	X	X	X	X	X	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	11	15	2L	10	14	2 $\frac{1}{2}$ L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2L	2L	-						
	3rd	X	X	X	X	X	X	X	X	X	3 $\frac{1}{2}$ L	3L	3L	3L	3L	3L	3L	3L	3 $\frac{1}{2}$ L	3L	3L	-						
+5	1st	X	X	X	X	X	X	X	X	X	15	15	2L	11	14	2L	10	13	15	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2L	2L	-						
	3rd	X	X	X	X	X	X	X	X	X	3 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	3L	3L	3L	3L	3L	3L	3L	2 $\frac{1}{2}$ L	-						
GROUND LEVEL	1st	X	X	13	X	X	13	X	14	14	14	13	14	10	12	13	10	12	13	9	11	-						
	2nd	X	X	14	X	X	15	X	X	X	2 $\frac{1}{2}$ L	2L	2L	2L	2L	2L	2L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2L	2L	-						
	3rd	X	X	14	X	X	X	X	X	X	3L	2 $\frac{1}{2}$ L	2L	3L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	3L	3L	3L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	-						
-5	1st	X	12	8	X	13	9	X	12	10	13	11	11	9	11	11	10	11	11	9	11	-						
	2nd	X	14	8	X	X	11	X	13	X	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	X	10	X	X	X	13	X	X	2 $\frac{1}{2}$ L	2L	2L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	3L	3L	-						
-10	1st	X	8	4	X	10	5	15	9	7	12	9	8	9	9	9	9	10	10	9	10	-						
	2nd	X	10	4	X	13	7	X	13	10	2L	14	12	2L	15	14	2L	2L	2L	2L	2L	-						
	3rd	X	12	5	X	X	9	X	X	12	2 $\frac{1}{2}$ L	2L	15	2 $\frac{1}{2}$ L	2L	2L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2L	3L	3L	-						
-15	1st	15	4	1	X	6	1	14	6	3	11	7	5	8	8	6	8	8	8	8	9	-						
	2nd	X	6	1	X	9	3	X	10	6	2L	12	9	2L	14	11	2L	2L	14	2L	2L	-						
	3rd	X	8	1	X	12	5	X	15	9	2L	2L	13	2L	2L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	2L	3L	2 $\frac{1}{2}$ L	-							
-20	1st	13	1	1	14	3	1	13	4	1	10	5	2	8	6	4	8	7	6	8	8	-						
	2nd	X	2	1	X	6	1	X	8	2	2L	10	6	2L	13	9	2L	14	12	2L	2L	-						
	3rd	X	3	1	X	9	1	X	12	5	2L	2L	10	2L	2L	14	2 $\frac{1}{2}$ L	2L	2L	2 $\frac{1}{2}$ L	2 $\frac{1}{2}$ L	-						

VOLUME 96,000 (VEH/DAY) SPEED 40 (MPH) %TRUCK 10% %GRADE 0 to 3

TABLE: 1-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3L	3L	12	2½L	3L	11	15	2½L	10	13	2½L	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	-	
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	-	
+15	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	2½L	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2L	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3L	3L	-
+10	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	15	2½L	2½L	11	15	2½L	10	13	2L	10	12	15	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	2½L	3L	2L	2L	2L	2½L	2½L	3L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3½L	3½L	3L	3L	3½L	3L	3L	3L	3L	3L	3L	3L	3L	-
+5	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2L	14	15	2L	11	14	2L	10	13	15	9	12	14	9	11	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	3½L	3L	3L	3L	3L	3L	3L	2½L	2½L	3½L	3½L	3½L	3½L	3½L	-
GROUND LEVEL	1st	X	X	13	X	X	15	X	X	15	2½L	2L	15	14	14	14	10	12	14	10	12	14	9	11	13	9	11	-
	2nd	X	X	14	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2½L	2½L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	15	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	3L	3L	2½L	2½L	3L	3½L	3L	3½L	3½L	-
-5	1st	X	X	9	X	X	10	X	X	11	2½L	2L	12	13	12	12	10	11	12	9	11	12	9	11	12	9	11	-
	2nd	X	X	10	X	X	12	X	X	14	3L	2L	15	2½L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	11	X	X	14	X	X	X	3½L	2½L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-
-10	1st	X	12	4	X	15	6	X	X	8	2L	14	9	13	11	10	10	10	10	9	10	11	9	10	11	9	10	-
	2nd	X	14	5	X	X	8	X	X	10	2½L	2L	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-
	3rd	X	15	6	X	X	10	X	X	13	3L	2L	2L	3L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	-
-15	1st	X	8	1	X	11	2	X	13	5	2L	12	6	12	9	7	9	9	9	9	10	10	9	10	10	9	10	-
	2nd	X	10	1	X	14	5	X	X	7	2L	2L	10	2L	2L	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-
	3rd	X	11	1	X	X	5	X	X	10	2½L	2L	13	3L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-
-20	1st	X	4	1	X	8	1	X	10	1	15	10	3	12	8	5	9	8	7	9	9	8	9	9	9	9	10	-
	2nd	X	6	1	X	11	1	X	15	3	2L	15	7	2L	14	10	2L	15	3	2L	2L	15	2L	2L	2L	2L	2L	-
	3rd	X	7	1	X	14	1	X	X	6	2½L	2L	11	2½L	2L	15	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	2L	-

VOLUME: 140,000 (VEH./DAY)

SPEED: 40 (MPH)

%TRUCK: 10%

%GRADE: 0 to

TABLE: 1-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4½L	4L	4L	4L	3L	3L	3L	12½L	2½L	10	14	2L	10	13	2L	
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	4½L	4½L	4L	4L	4L	3½L	3L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	5½L	5½L	4½L	4½L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	3½L	
+15	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3L	3L	12	2L	2½L	10	14	2L	10	13	2L	
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	3½L	3½L	3½L	3L	3L	2½L	3L	3L	2½L	3L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4L	4½L	4½L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	3½L
+10	1st	X	X	X	X	X	X	X	X	X	4L	4L	3L	3½L	3½L	3L	3L	3L	2½L	11	15	2½L	10	13	2½L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	3½L	4L	4L	3½L	3½L	3½L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	2½L	2½L	2½L	11	14	2L	10	13	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	4L	3L	3½L	3½L	3L	2½L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	4½L	4L	3½L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	2½L	3L	2½L	2½L	2L	11	13	15	10	12	14	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	4L	3½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	5L	4½L	4L	4L	4L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	15	X	X	X	X	X	X	3½L	3L	2L	3L	3L	2L	2½L	2½L	15	11	13	14	10	12	13	9	11	13
	2nd	X	X	15	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4½L	4L	3L	4L	3½L	3L	3½L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L
-10	1st	X	X	11	X	X	14	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2L	13	11	12	12	9	11	12	9	11	12
	2nd	X	X	11	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	12	X	X	X	X	X	X	4L	3L	2L	4L	3½L	2½L	4L	3½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-15	1st	X	14	6	X	X	10	X	X	13	2½L	2L	15	2½L	2½L	14	15	2L	11	10	11	11	9	11	11	9	11	12
	2nd	X	X	7	X	X	12	X	X	X	3L	2½L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L
	3rd	X	X	7	X	X	14	X	X	X	3½L	2½L	2L	4L	3½L	2½L	3½L	3L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L
-20	1st	X	10	2	X	X	6	X	X	10	2½L	2L	12	2½L	2L	12	2L	15	9	10	10	10	9	10	10	9	10	11
	2nd	X	12	2	X	X	8	X	X	13	3L	2L	2L	3L	2½L	2L	3L	2½L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L
	3rd	X	14	3	X	X	9	X	X	15	3½L	2L	2L	3½L	3L	2L	3½L	3L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L

VOLUME 220,000 (YH/DAY)

SPEED 40 (MPH)

%TRUCK 10%

%GRADE 0 to 10

VOLUME: 220,000 (VEH./DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 2-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	X	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	8	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	-	-																									
	2nd	3	-																									
	3rd	6	-																									

VOLUME: 5,600 (VEH./DAY)

SPEED: 40 (M.P.H.)

%TRUCK: 10%

%GRADE: 4 TO



TABLE: 2-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 8,400 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	X	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	8	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	-	-																									
	2nd	3	-																									
	3rd	7	-																									

TABLE: 2-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 13,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+15	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+10	1st	X	-	-	14	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+5	1st	14	-	-	12	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
GROUND LEVEL	1st	11	-	-	10	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
-5	1st	8	-	-	8	-																						
	2nd	12	-	-	14	-																						
	3rd	15	-	-	X	-																						
-10	1st	5	-	-	6	-																						
	2nd	9	-	-	12	-																						
	3rd	12	-	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	-	-	15	-																						
-20	1st	1	-	-	3	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	13	-																						

TABLE: 2-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	-	X	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
+15	1st	X	X	-	X	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
+10	1st	X	X	-	14	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
+5	1st	14	X	-	12	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
GROUND LEVEL	1st	11	12	-	11	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-5	1st	8	8	-	8	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	12	9	-	14	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	X	11	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-10	1st	5	3	-	6	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	9	5	-	12	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	13	7	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-15	1st	2	-	-	4	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	6	-	-	10	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	10	3	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-20	1st	-	-	-	3	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2nd	3	-	-	8	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3rd	7	-	-	14	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

VOLUME 19,000 (VEH/DAY)

SPEED: 40 (MPH)

%TRUCK: 10%

%GRADE: 4 to

VOLUME: 19,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 2-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	X	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	-	X	X	-	14	X	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	-	14	X	-	13	X	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	15	X	-	13	15	-	11	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	12	12	-	10	12	-	10	12	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	12	-	X	X	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	-	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	9	8	-	9	8	-	9	9	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	13	9	-	14	11	-	15	13	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	-	X	14	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	6	4	-	7	5	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	10	5	-	12	8	-	14	11	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	14	7	-	X	11	-	X	15	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	3	1	-	5	2	-	6	4	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	7	1	-	10	5	-	13	8	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	11	3	-	X	8	-	X	12	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	1	1	-	3	-	-	5	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	4	1	-	8	-	-	12	5	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	8	1	-	14	4	-	X	10	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME: 28,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 2-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 43,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+15	1st	X	X	X	X	X	X	14	X	-	12	2½L	-	11	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+10	1st	X	X	X	15	X	X	13	X	-	11	2½L	-	11	14	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2L	-												
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	3L	-												
+5	1st	X	X	X	13	15	X	12	15	-	11	14	-	10	13	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	3L	2½L	-	3L	3L	-												
GROUND LEVEL	1st	15	12	12	12	12	12	10	12	-	10	12	-	9	11	-												
	2nd	X	14	13	X	15	14	X	X	-	2L	13	-	2L	2L	-												
	3rd	X	15	14	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
-5	1st	12	8	8	10	9	8	9	9	-	9	10	-	9	10	-												
	2nd	X	10	8	15	12	10	X	14	-	2L	15	-	2L	2L	-												
	3rd	X	11	9	X	15	12	X	X	-	2L	2L	-	2½L	2½L	-												
-10	1st	9	4	3	8	5	4	8	7	-	8	8	-	8	8	-												
	2nd	13	5	4	13	8	6	14	11	-	15	13	-	2L	15	-												
	3rd	X	7	15	X	11	8	X	15	-	2L	2L	-	2L	2L	-												
-15	1st	7	1	-	6	2	-	6	4	-	7	6	-	8	7	-												
	2nd	10	1	-	11	5	2	13	8	-	15	11	-	2L	13	-												
	3rd	14	3	-	X	8	4	X	12	-	2L	2L	-	2L	2L	-												
-20	1st	4	1	-	4	1	-	5	1	-	6	4	-	7	5	-												
	2nd	8	1	-	9	2	-	12	6	-	14	9	-	15	12	-												
	3rd	12	1	-	15	5	-	X	10	-	2L	14	-	2L	2L	-												

TABLE: 2-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 64,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3½L	3½L	3L	3L	2½L	-								
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	-							
+15	1st	X	X	X	X	X	X	X	X	X	13	2½L	3L	11	2½L	2½L	11	15	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-							
+10	1st	X	X	X	X	X	X	X	X	X	12	2½L	2½L	11	15	2½L	10	14	2L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-							
+5	1st	X	X	X	X	X	X	15	15	X	11	14	2L	10	13	15	10	12	15	9	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	-							
GROUND LEVEL	1st	X	13	12	X	14	13	14	13	13	10	12	13	10	12	13	9	11	13	9	-							
	2nd	X	14	13	X	15	X	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-							
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	3L	3L	-							
-5	1st	X	9	8	X	10	9	13	10	10	10	10	10	9	10	11	9	10	11	9	-							
	2nd	X	10	8	X	12	11	X	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	-							
	3rd	X	12	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	-							
-10	1st	14	15	3	14	6	5	11	8	6	9	8	8	9	9	9	9	9	9	9	-							
	2nd	X	6	4	X	9	6	X	12	10	2L	14	11	2L	15	13	2L	2L	2L	2L	-							
	3rd	X	8	5	X	12	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	-							
-15	1st	11	1	1	12	3	-	10	5	3	8	6	5	8	7	6	8	8	8	8	-							
	2nd	15	2	1	X	6	2	X	9	5	15	12	8	2L	14	11	2L	15	13	2L	-							
	3rd	X	4	1	X	9	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	2L	3L	-							
-20	1st	8	1	1	10	1	-	9	3	-	7	4	2	7	6	4	8	7	6	8	-							
	2nd	13	1	1	15	2	-	15	6	2	15	10	5	15	12	9	2L	14	12	2L	-							
	3rd	X	1	1	X	5	-	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2L	-							

TABLE: 2-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	X	X	X	X	X	X	X	3L	3L	3½L	13	2½L	3L	11	2½L	2½L	10	14	2½L	10	13	-				
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	3L	2½L	2½L	-				
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3L	3½L	4L	3½L	3½L	-				
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	12	2½L	2½L	11	15	2½L	10	14	2½L	10	13	-				
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+10	1st	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	11	15	2½L	10	14	2L	10	13	2L	9	12	-				
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	3L	3L	-				
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+5	1st	X	X	X	X	X	X	X	X	X	15	15	2L	11	14	2L	10	13	15	10	12	14	9	12	-				
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-				
	3rd	X	X	X	X	X	X	X	X	X	3½L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-				
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	X	14	14	13	14	10	12	14	10	12	13	9	11	13	9	11	-			
	2nd	X	X	14	X	X	15	X	X	X	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-				
	3rd	X	X	15	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-				
-5	1st	X	14	8	X	X	10	X	15	10	13	11	11	10	11	11	9	11	12	9	11	12	9	11	-				
	2nd	X	X	9	X	X	11	X	X	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-				
	3rd	X	X	10	X	X	13	X	X	X	3L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-				
-10	1st	X	10	4	X	12	5	X	12	7	12	9	8	9	9	9	9	10	10	9	10	10	9	10	-				
	2nd	X	12	5	X	15	7	X	X	10	2L	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-				
	3rd	X	14	6	X	X	9	X	X	12	2½L	2L	15	2½L	2L	2L	2½L	2½L	2½L	3L	3L	3L	2½L	3L	-				
-15	1st	X	6	1	X	9	1	X	10	3	11	7	5	9	8	7	9	9	8	8	9	9	9	10	-				
	2nd	X	8	1	X	12	3	X	14	6	2L	12	9	2L	14	12	2L	2L	14	2L	2L	2L	2L	2L	-				
	3rd	X	10	1	X	15	5	X	X	9	2L	2L	13	2L	2L	2L	2½L	2½L	2L	3½L	2½L	2L	3L	3L	-				
-20	1st	15	2	1	X	6	1	15	7	1	10	5	2	8	6	4	8	8	6	8	8	8	8	9	-				
	2nd	X	4	1	X	9	1	X	11	3	2L	10	6	2L	13	9	2L	15	12	2L	2L	15	2L	2L	-				
	3rd	X	5	1	X	12	1	X	X	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2½L	2L	3L	3L	-				

VOLUME: 96,000 (VEH./DAY)

SPEED: 40 (MPH)

%TRUCK: 10%

%GRADE: 4 to

VOLUME: 96,000 (VEH./DAY) SPEED: 40 (M.P.H.) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 2-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3L	3L	3L	13	2½L	2½L	11	15	3L	10	14	2½L	10	13	2L	
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	3½L	3½L	3L	3L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L	
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	4L	3½L	4L	4L	4L	4L	4L	4L	3½L	3½L	4L	3½L	4L	
+15	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	3L	12	2L	2½L	11	14	2½L	10	13	2L	9	12	15	
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4L	3½L	3½L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	
+10	1st	X	X	X	X	X	X	X	X	X	3½L	3½L	2½L	3L	2½L	2½L	12	15	2L	10	14	2½L	10	13	15	9	12	14	
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3L	3L	2½L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	
+5	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	2½L	2½L	2L	11	14	2L	10	13	15	10	12	14	9	12	14	
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	2½L	3½L	3L	2½L	2½L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3½L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	
GROUND LEVEL	1st	X	X	15	X	X	X	X	X	X	3L	2½L	15	2½L	2L	15	11	13	14	10	12	14	9	12	13	9	11	13	
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	4L	3L	2½L	3½L	3½L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	
-5	1st	X	X	10	X	X	12	X	X	X	13	3L	2½L	13	2½L	15	13	11	12	13	10	11	13	9	11	12	9	11	12
	2nd	X	X	10	X	X	14	X	X	X	15	3½L	2L	3L	3L	2½L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	12	X	X	15	X	X	X	3½L	3L	3½L	3½L	3L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	
-10	1st	X	14	6	X	X	8	X	X	9	2½L	2L	11	15	13	10	10	11	11	9	11	11	9	11	12	9	10	12	
	2nd	X	X	7	X	X	10	X	X	12	3L	2½L	13	3L	2L	15	2L	2L	2L	2½L	2L	2L	2L	2½L	2L	2½L	2½L	2½L	
	3rd	X	X	8	X	X	11	X	X	15	3½L	2½L	2L	3½L	2½L	3L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	
-15	1st	X	10	1	X	14	5	X	X	6	2L	2L	7	15	12	9	10	10	9	9	10	10	9	10	11	9	10	11	
	2nd	X	12	2	X	X	6	X	X	8	2½L	2L	11	12	13	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	
	3rd	X	13	3	X	X	7	X	X	11	3L	2L	14	3L	2L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	
-20	1st	X	6	1	X	11	1	X	13	2	2L	2L	4	14	10	6	10	9	7	9	9	9	9	10	10	9	10	10	
	2nd	X	8	1	X	14	2	X	X	5	2½L	2L	8	2½L	2L	11	2L	2L	13	2L	2L	15	2L	2L	2L	2L	2L	2L	
	3rd	X	9	1	X	X	3	X	X	8	3L	2L	12	3L	2L	15	2½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	

VOLUME: 140,000 (VEH/DAY)

SPEED: 40 (MPH)

%TRUCK: 10%

%GRADE: 4 to



TABLE: 2-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5L	5L	4½L	4½L	4½L	4½L	3½L	3½L	3½L	15	2½L	3L	10	14	2½L	10	13	2½L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	5L	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5½L	5½L	5L	5L	5L	5L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L
+15	1st	X	X	X	X	X	X	X	X	X	5L	4L	4L	4L	4½L	4L	3½L	3½L	3½L	15	2½L	2½L	10	12	2L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4L	4L	4L	3½L	3L	4L	3½L	3L	3L	2½L	3L	2L
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	5L	4½L	4L	4L	4L	3½L	3L	4L	3½L	3L	3L
+10	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3L	3½L	3L	14	2½L	2½L	10	13	2L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	4L	4L	3½L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5½L	5L	4½L	5L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	3½L	3½L	3L	3L	3L	14	2L	2L	10	13	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4½L	3½L	4L	4L	3½L	3L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	5L	4L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	3L	3L	2½L	14	15	2L	10	12	14	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	4L	3½L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	5L	4½L	4L	4½L	4½L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	3L	3L	2½L	14	15	15	10	12	13	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3½L	4½L	4L	3½L	4L	3½L	3L	3½L	3½L	3L	3½L	3½L	3½L
-10	1st	X	X	12	X	X	X	X	X	X	3½L	3L	2L	3L	3L	2½L	2½L	2½L	2L	13	14	13	9	11	12	9	11	12
	2nd	X	X	13	X	X	X	X	X	X	4L	3L	2½L	4L	3½L	2½L	3½L	3½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	14	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3L	4½L	4L	3L	3½L	3½L	3L	3L	3L	3L	3L	3L	3L
-15	1st	X	X	7	X	X	13	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2½L	2L	13	13	12	9	11	11	9	11	12
	2nd	X	X	8	X	X	14	X	X	X	3½L	2½L	2L	3½L	3L	2½L	2½L	3L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	9	X	X	X	X	X	X	4L	3L	2L	4½L	3½L	2½L	4L	3½L	3L	3½L	3L	3L	3L	3L	3L	3L	3L	3L
-20	1st	X	13	3	X	X	9	X	X	13	3L	2L	2L	3L	2½L	2L	2½L	2L	14	13	12	11	9	10	10	9	10	11
	2nd	X	15	4	X	X	10	X	X	X	3½L	2½L	2L	3½L	3L	2L	3L	3L	2L	2½L	2½L	2L	2L	2L	2L	2L	2L	2L
	3rd	X	X	5	X	X	12	X	X	X	3½L	2½L	2L	4L	3½L	2½L	4L	3½L	2½L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L

VOLUME 220,000 (VEH/DAY) SPEED 40 (MPH) %TRUCK 10% %GRADE 4 TO 6

TABLE: 3-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	X	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	8	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	-	-																									
	2nd	3	-																									
	3rd	6	-																									

VOLUME

5,600

(VEH./DAY)

SPEED

40

(MPH)

% TRUCKS

10%

% GRADE

+/

VOLUME 5,600 (VEH/DAY) SPEED 40 (MPH) %TRUCK 10% %GRADE 7+

TABLE: 3-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME	13,000 (VEH./DAY)	SPEED	40 (M.P.H.)	%TRUCK	10%	%GRADE	7%
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[illegible][illegible]

TABLE: 3-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-	-	X	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
+15	1st	X	X	-	X	-	-	X	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
+10	1st	X	X	-	14	-	-	12	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
+5	1st	14	X	-	12	-	-	11	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
GROUND LEVEL	1st	11	12	-	10	-	-	10	-																			
	2nd	15	13	-	X	-	-	X	-																			
	3rd	X	15	-	X	-	-	X	-																			
-5	1st	8	8	-	8	-	-	8	-																			
	2nd	12	9	-	14	-	-	15	-																			
	3rd	X	11	-	X	-	-	X	-																			
-10	1st	5	4	-	6	-	-	7	-																			
	2nd	9	5	-	12	-	-	14	-																			
	3rd	13	7	-	X	-	-	X	-																			
-15	1st	2	-	-	4	-	-	6	-																			
	2nd	6	-	-	10	-	-	13	-																			
	3rd	10	3	-	X	-	-	X	-																			
-20	1st	1	-	-	3	-	-	5	-																			
	2nd	3	-	-	8	-	-	11	-																			
	3rd	7	-	-	14	-	-	X	-																			

VOLUME: 19,000 (VEH./DAY)

SPEED: 40 (M.P.H.)

% TRUCK: 10%

% GRADE: 1%

VOLUME: 19,000 (VEH./DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 7+

TABLE: 3-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	X	X	-	13	2L	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	2L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	2L	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	-	X	X	-	X	X	-	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	-	15	X	-	13	X	-	11	2L	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	-	13	15	-	11	14	-	10	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	14	12	-	11	12	-	10	12	-	10	12	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	-	X	X	-	X	X	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	-	X	X	-	X	X	-	2½L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	11	8	-	9	9	-	9	9	-	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	14	9	-	14	12	-	X	13	-	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	-	X	14	-	X	X	-	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	8	4	-	7	5	-	8	7	-	8	8	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	12	5	-	13	8	-	14	11	-	15	13	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	15	7	-	X	11	-	X	15	-	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	5	1	-	5	2	-	6	4	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	9	1	-	11	5	-	13	8	-	15	11	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	13	3	-	X	8	-	X	12	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	2	1	-	3	1	-	5	-	-	6	4	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	6	1	-	9	1	-	12	5	-	14	9	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	10	1	-	14	4	-	X	10	-	2L	14	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME: 28,000 (VEH./DAY) SPEED: 40 (MPH) %TRUCK: 10% %GRADE: 7+

TABLE: 3-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	13	3L	3L	12	2½L	-	11	-										
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	-	2½L	-										
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3½L	3½L	-	3L	-										
+15	1st	X	X	X	X	X	X	15	X	X	12	2½L	3L	11	2½L	-	10	-										
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	-	2½L	-										
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	-	3½L	-										
+10	1st	X	X	X	X	X	X	13	10	X	12	2½L	2½L	11	14	-	10	-										
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	-	2½L	-										
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	-	3L	-										
+5	1st	X	X	X	X	X	X	12	15	X	11	14	2L	10	13	-	10	-										
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-										
	3rd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	3L	3L	-	3L	-										
GROUND LEVEL	1st	X	12	12	14	12	13	11	12	13	10	12	13	9	11	-	9	-										
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	-	2½L	-										
	3rd	X	15	14	X	X	X	X	X	X	2½L	2L	2L	2½L	2½L	-	3L	-										
-5	1st	14	8	8	12	9	9	9	9	9	9	10	10	9	10	-	9	-										
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	2L	-	2L	-										
	3rd	X	11	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	-										
-10	1st	11	4	3	10	6	4	8	7	6	8	8	7	8	9	-	8	-										
	2nd	15	6	4	15	8	6	15	11	10	2L	13	11	2L	15	-	2L	-										
	3rd	X	7	5	X	11	8	X	15	11	2L	2L	15	2L	2L	-	2½L	-										
-15	1st	8	1	-	8	2	-	7	4	2	7	6	4	8	7	-	8	-										
	2nd	12	2	-	14	5	2	13	8	5	15	11	8	2L	13	-	2L	-										
	3rd	X	3	-	X	8	4	X	13	8	2L	2L	12	2L	2L	-	2½L	-										
-20	1st	5	1	-	6	1	-	5	2	-	6	4	-	7	6	-	8	-										
	2nd	9	1	-	12	2	-	12	6	2	14	9	5	15	12	-	2L	-										
	3rd	13	1	-	X	5	-	X	11	4	2L	15	9	2L	2L	-	2½L	-										

VOLUME 43,000 (VEH/DAY) SPEED 40 (MPH) %TRUCK 10% %GRADE 7+

TABLE: 3-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	15	3L	3½L	12	2½L	3L	11	2½L	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	3½L	4L	3L	3½L	-					
+15	1st	X	X	X	X	X	X	X	X	X	14	2½L	3L	12	2½L	2½L	11	15	2L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	3L	3L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-						
+10	1st	X	X	X	X	X	X	X	X	X	13	2½L	2½L	11	15	2½L	10	14	2L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-						
+5	1st	X	X	X	X	X	X	X	X	X	12	15	2L	11	14	2L	10	13	15	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-						
GROUND LEVEL	1st	X	14	12	X	14	13	X	13	13	11	13	13	10	12	13	10	12	13	9	11	-						
	2nd	X	X	13	X	X	14	X	X	X	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	14	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-						
-5	1st	X	10	8	X	10	9	15	10	10	10	11	11	9	11	11	9	11	11	9	11	-						
	2nd	X	12	8	X	13	11	X	15	13	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	13	10	X	X	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	-						
-10	1st	X	6	3	X	7	5	13	8	6	10	9	8	9	9	9	9	10	10	9	10	-						
	2nd	X	8	4	X	10	7	X	12	10	2L	14	11	2L	15	14	2L	2L	2L	2L	2L	-						
	3rd	X	9	5	X	13	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	3L	-						
-15	1st	13	2	1	14	5	1	12	5	3	9	6	5	8	8	6	8	8	8	8	9	-						
	2nd	X	3	1	X	7	3	X	9	6	2L	12	9	2L	14	11	2L	14	12	2L	2L	-						
	3rd	X	5	1	X	10	4	X	14	8	2L	2L	12	2L	2L	2L	2½L	2½L	2L	3L	2½L	-						
-20	1st	10	1	1	12	1	1	11	3	1	8	5	2	8	6	4	8	7	6	8	8	-						
	2nd	14	1	1	X	3	1	X	7	2	15	10	6	2L	13	9	2L	14	12	2L	2L	-						
	3rd	X	1	1	X	6	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	2½L	-						

VOLUME 64,000 (VEH/DAY) SPEED 40 (MPH) %TRUCK 10% %GRADE 7+



TABLE: 3-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	2½L	3L	3½L	13	2½L	3L	11	2½L	2½L	10	152½L	10	13	2L	-	-	-	
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3½L	3½L	3L	3½L	3½L	2½L	3L	3L	2½L	2½L	3L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	4L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	4L	-	-	-
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	13	2½L	3L	11	15	2½L	10	142½L	10	13	2L	-	-	-	
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	3L	3L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-
+10	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	12	14	2½L	11	14	2½L	10	13	2L	9	12	15	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	3L	2½L	2½L	2½L	2½L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-
+5	1st	X	X	X	X	X	X	X	X	X	2½L	2L	2L	12	14	2L	10	13	15	10	12	15	9	12	14	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	-	-	-
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	14	2½L	14	14	11	13	14	10	12	14	9	12	13	9	11	13	-	-	-
	2nd	X	X	14	X	X	15	X	X	15	3L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-
	3rd	X	X	15	X	X	16	X	X	16	3½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-	-	-
-5	1st	X	14	8	X	X	10	X	15	10	15	12	11	11	12	10	11	12	9	11	12	9	11	12	-	-	-	
	2nd	X	9	9	X	X	11	X	13	13	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	-	-	-
	3rd	X	11	10	X	X	13	X	15	15	3L	2L	2L	3L	2½L	2L	3L	3L	3L	2½L	3L	3L	3L	3L	3L	-	-	-
-10	1st	X	10	4	X	12	5	X	12	7	14	10	8	10	10	9	9	10	10	9	10	11	9	10	11	-	-	-
	2nd	X	5	5	X	15	7	X	10	10	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	7	6	X	9	9	X	12	12	2½L	2L	2L	2½L	2L	2L	3L	2½L	2½L	3L	2½L	2½L	3L	3L	3L	-	-	-
-15	1st	X	6	1	X	9	1	X	10	3	13	8	5	9	8	7	9	9	8	9	9	9	9	10	10	-	-	-
	2nd	X	1	1	X	12	13	X	14	6	2L	13	9	2L	15	12	2L	14	2L	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	3	1	X	15	4	X	9	9	2½L	2L	132½L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	-	-	-	
-20	1st	15	2	1	X	6	1	15	7	1	13	6	2	9	7	5	8	8	7	8	9	8	8	9	9	-	-	-
	2nd	X	1	1	X	9	1	X	11	3	2L	11	6	2L	13	10	2L	15	12	2L	2L	15	2L	2L	2L	-	-	-
	3rd	X	1	1	X	12	1	X	5	5	2L	2L	10	2L	2L	142½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	-	-	-	

VOLUME: 96,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 10 %GRADE: 7+

TABLE: 3-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	X	X	X	X	X	X	X	4 1/2 L	4 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	15	2 1/2 L	3 L	11	2 L	2 1/2 L	10	14 1/2 L	10	13	2 L		
	2nd	X	X	X	X	X	X	X	X	X	5 L	4 1/2 L	4 L	4 1/2 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 L	3 L	3 1/2 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L		
	3rd	X	X	X	X	X	X	X	X	X	5 1/2 L	4 L	4 1/2 L	5 L	4 1/2 L	4 L	4 L	4 L	4 L	4 L	4 L	4 L	3 1/2 L	3 1/2 L	4 L	3 1/2 L	3 1/2 L	4 L	
+15	1st	X	X	X	X	X	X	X	X	X	4 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 L	15	2 1/2 L	2 1/2 L	11	15	2 1/2 L	10	13	2 L	10	12	15	
	2nd	X	X	X	X	X	X	X	X	X	4 1/2 L	4 1/2 L	3 1/2 L	4 L	4 L	3 1/2 L	3 1/2 L	3 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L	2 1/2 L	2 1/2 L	3 L	
	3rd	X	X	X	X	X	X	X	X	X	5 L	4 1/2 L	4 L	4 1/2 L	4 L	4 L	4 L	4 L	4 L	4 L	4 L	4 L	4 L	3 1/2 L	3 1/2 L	3 L	2 1/2 L	2 1/2 L	3 L
+10	1st	X	X	X	X	X	X	X	X	X	4 1/2 L	4 L	3 L	4 L	3 1/2 L	3 L	3 L	15	2 1/2 L	2 1/2 L	11	14	2 L	10	13	2 L	9	12	15
	2nd	X	X	X	X	X	X	X	X	X	4 1/2 L	4 L	3 L	4 L	3 1/2 L	3 L	3 L	3 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L	
	3rd	X	X	X	X	X	X	X	X	X	5 L	4 1/2 L	3 1/2 L	4 1/2 L	4 L	3 1/2 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	
+5	1st	X	X	X	X	X	X	X	X	X	2 1/2 L	3 L	3 1/2 L	3 L	3 L	2 1/2 L	14	14	2 L	10	13	2 L	10	12	15	9	12	14	
	2nd	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	3 L	3 1/2 L	3 1/2 L	2 1/2 L	3 L	3 L	3 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	
	3rd	X	X	X	X	X	X	X	X	X	4 1/2 L	4 L	3 L	4 1/2 L	4 L	3 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	2 L	3 L	2 1/2 L	2 L	14	14	15	10	13	2 L	10	12	14	9	11	13	
	2nd	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	2 1/2 L	3 1/2 L	3 L	2 1/2 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	
	3rd	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	2 1/2 L	4 L	3 1/2 L	3 L	3 1/2 L	3 L	3 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	
-5	1st	X	X	13	X	X	15	X	X	X	3 L	2 1/2 L	2 L	2 1/2 L	2 1/2 L	14	13	13	13	10	12	13	9	11	13	9	11	13	
	2nd	X	X	14	X	X	16	X	X	X	3 1/2 L	3 L	2 L	3 L	2 1/2 L	3 L	2 1/2 L	2 L	2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	
	3rd	X	X	14	X	X	16	X	X	X	4 L	3 L	2 L	4 L	3 1/2 L	2 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	
-10	1st	X	X	8	X	X	11	X	X	X	2 1/2 L	2 L	13	2 1/2 L	2 L	12	13	12	12	10	11	12	9	11	12	9	11	12	
	2nd	X	X	9	X	X	13	X	X	X	3 L	2 1/2 L	2 L	3 L	2 1/2 L	2 L	2 1/2 L	2 L	2 L	2 1/2 L	2 L	2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	
	3rd	X	X	10	X	X	15	X	X	X	3 1/2 L	2 1/2 L	2 L	4 L	3 L	2 L	3 1/2 L	3 L	2 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	
-15	1st	X	12	3	X	X	8	X	X	10	2 1/2 L	2 L	10	2 1/2 L	2 L	9	13	11	10	9	10	10	9	10	11	9	10	11	
	2nd	X	14	4	X	X	9	X	X	13	3 L	2 L	14	3 L	2 1/2 L	14	2 1/2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	
	3rd	X	15	5	X	X	11	X	X	15	3 1/2 L	2 1/2 L	2 L	3 1/2 L	3 L	2 L	3 1/2 L	2 1/2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	
-20	1st	X	8	1	X	13	3	X	X	6	2 L	2 L	7	2 L	15	7	12	10	8	9	10	9	9	10	10	9	10	11	
	2nd	X	10	1	X	X	5	X	X	9	2 1/2 L	2 L	11	2 1/2 L	2 L	12	2 1/2 L	2 L	14	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	
	3rd	X	11	1	X	X	7	X	X	12	3 L	2 L	15	3 L	2 1/2 L	2 L	3 L	2 1/2 L	2 L	3 L	2 1/2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]

### MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]

TABLE 4-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME	6,400 (VEH./DAY)	SPEED	40 (MPH)	%TRUCK	20	%GRADE	0 TO 10
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[illegible]

TABLE 2-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME	SPEED	%TRUCK	%GRADE
15,000 (VEH/DAY)	40 (MPH)	10	10

[illegible]

TABLE: 4-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	-	X	-	-	15	-	-																			
	2nd	X	X	-	X	-	-	X	-	-																			
	3rd	X	X	-	X	-	-	X	-	-																			
+15	1st	X	X	-	X	-	-	14	-	-																			
	2nd	X	X	-	X	-	-	X	-	-																			
	3rd	X	X	-	X	-	-	X	-	-																			
+10	1st	X	X	X	14	-	-	12	X	-																			
	2nd	X	X	X	X	-	-	X	X	-																			
	3rd	X	X	X	X	-	-	X	X	-																			
+5	1st	14	X	X	12	-	-	11	14	-																			
	2nd	X	X	X	X	-	-	X	X	-																			
	3rd	X	X	X	X	-	-	X	X	-																			
GROUND LEVEL	1st	11	X	X	X	-	-	X	12	-																			
	2nd	15	X	X	10	-	-	10	12	-																			
	3rd	X	X	X	X	-	-	X	X	-																			
-5	1st	8	8	-	8	-	-	8	-	-																			
	2nd	12	9	-	14	-	-	15	-	-																			
	3rd	X	11	-	X	-	-	X	-	-																			
-10	1st	5	3	-	6	-	-	7	-	-																			
	2nd	9	5	-	12	-	-	14	-	-																			
	3rd	13	7	-	X	-	-	X	-	-																			
-15	1st	2	-	-	4	-	-	6	-	-																			
	2nd	6	-	-	10	-	-	12	-	-																			
	3rd	10	3	-	X	-	-	X	-	-																			
-20	1st	1	-	-	3	-	-	5	-	-																			
	2nd	3	-	-	8	-	-	11	-	-																			
	3rd	7	-	-	14	-	-	X	-	-																			

VOLUME 19,000 (VEH/DAY)

SPEED: 40 (MPH)

%TRUCK: 20%

%GRADE: 0 to 3

VOLUME: 19,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 4-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	X	X	-	13	-																
	2nd	X	X	-	X	X	-	X	X	-	3L	-																
	3rd	X	X	-	X	X	-	X	X	-	3½L	-																
+15	1st	X	X	-	X	X	-	X	X	-	12	-																
	2nd	X	X	-	X	X	-	X	X	-	2½L	-																
	3rd	X	X	-	X	X	-	X	X	-	3L	-																
+10	1st	X	X	-	15	X	-	13	X	-	11	-																
	2nd	X	X	-	X	X	-	X	X	-	2½L	-																
	3rd	X	X	-	X	X	-	X	X	-	3L	-																
+5	1st	15	X	-	13	15	-	11	14	-	10	-																
	2nd	X	X	-	X	X	-	X	X	-	2L	-																
	3rd	X	X	-	X	X	-	X	X	-	2½L	-																
GROUND LEVEL	1st	12	12	-	11	12	-	10	12	-	10	-																
	2nd	X	13	-	X	15	-	X	X	-	2L	-																
	3rd	X	15	-	X	X	-	X	X	-	2½L	-																
-5	1st	9	8	-	9	8	-	9	9	-	9	-																
	2nd	13	9	-	14	11	-	15	13	-	X	-																
	3rd	X	11	-	X	14	-	X	X	-	X	-																
-10	1st	6	4	-	7	5	-	7	6	-	8	-																
	2nd	10	5	-	12	8	-	14	11	-	15	-																
	3rd	14	15	-	X	11	-	X	15	-	X	-																
-15	1st	3	1	-	5	2	-	6	4	-	7	-																
	2nd	7	1	-	10	5	-	13	8	-	14	-																
	3rd	11	3	-	X	8	-	X	12	-	X	-																
-20	1st	1	1	-	3	-	-	5	-	-	6	-																
	2nd	4	1	-	8	-	-	12	5	-	14	-																
	3rd	8	1	-	14	4	-	X	10	-	X	-																

VOLUME: 28,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 0 to 3



TABLE 4-1

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+15	1st	X	X	X	X	X	X	14	X	-	12	2½L	-	11	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+10	1st	X	X	X	15	X	X	13	X	-	11	2½L	-	11	14	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	3L	-												
+5	1st	X	X	X	15	15	X	12	15	-	11	14	-	10	13	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	3L	-												
GROUND LEVEL	1st	15	12	12	12	12	12	10	X	-	10	12	-	9	11	-												
	2nd	X	14	13	X	15	14	X	X	-	2L	2L	-	2L	2L	-												
	3rd	X	15	14	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
-5	1st	12	8	8	10	9	8	9	9	-	9	10	-	9	10	-												
	2nd	X	10	8	15	12	10	X	14	-	2L	15	-	2L	2L	-												
	3rd	X	11	9	X	15	12	X	X	-	2L	2L	-	2½L	2½L	-												
-10	1st	9	4	3	8	5	4	8	7	-	10	8	-	8	8	-												
	2nd	13	5	4	13	8	6	14	11	-	15	13	-	2L	15	-												
	3rd	X	7	5	X	11	8	X	15	-	2L	2L	-	2L	2L	-												
-15	1st	7	1	-	6	2	-	6	4	-	7	6	-	8	7	-												
	2nd	10	1	-	11	5	2	13	8	-	15	11	-	2L	13	-												
	3rd	14	3	-	X	8	4	X	12	-	2L	2L	-	2L	2L	-												
-20	1st	4	1	-	4	1	-	5	1	-	6	4	-	7	5	-												
	2nd	8	1	-	9	2	-	12	6	-	14	9	-	15	12	-												
	3rd	12	1	-	15	5	-	X	10	-	2L	14	-	2L	2L	-												

VOLUME 43,000 (VEH/DAY) SPEED 40 (M.P.H.) %TRUCK 20 %GRADE 0 to 3

TABLE 4-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	4L	3L	3L	3½L	2½L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	-							
+15	1st	X	X	X	X	X	X	X	X	X	13	2½L	3L	11	2½L	2½L	11	2L	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-							
+10	1st	X	X	X	X	X	X	X	X	X	2L	2½L	2½L	11	15	2½L	10	14	2L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	3L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	-							
+5	1st	X	X	X	X	X	X	15	15	X	11	14	2L	10	13	15	10	12	15	9	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	-							
GROUND LEVEL	1st	X	13	12	X	13	13	14	13	13	10	12	13	10	12	13	9	11	13	9	-							
	2nd	X	14	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-							
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	3L	3L	-							
-5	1st	X	9	8	X	10	9	13	10	10	10	10	10	9	10	11	9	10	11	9	-							
	2nd	X	10	8	X	12	11	X	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	-							
	3rd	X	12	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	-							
-10	1st	14	5	3	14	6	5	11	7	6	9	8	7	9	9	9	9	9	9	9	-							
	2nd	X	6	4	X	9	6	X	12	10	2L	14	11	2L	15	3	2L	2L	2L	2L	-							
	3rd	X	8	5	X	12	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2½L	3L	-							
-15	1st	11	1	1	12	3	1	10	5	3	8	6	5	8	7	6	8	8	8	8	-							
	2nd	15	2	1	X	6	2	X	9	5	15	12	8	2L	14	11	2L	15	13	2L	-							
	3rd	X	4	1	X	9	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	2L	3L	-							
-20	1st	8	1	1	10	1	1	9	2	1	7	4	2	7	6	4	8	7	6	8	-							
	2nd	13	1	1	15	2	1	15	6	2	15	10	5	15	12	9	2L	14	12	2L	-							
	3rd	X	1	1	X	5	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	-							

VOLUME 64,000 (VEH/DAY) SPEED 40 (M.P.H.) %TRUCK 10 %GRADE 0 to 3





TABLE: 5-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 8,400 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 4 to 6

ROAD ELEVATION (FT.)		RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
			110			170			250			380			570			850			1300			1900			2900		
			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
			1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-		X	-																							
	2nd	X	-		X	-																							
	3rd	X	-		X	-																							
+15	1st	X	-		X	-																							
	2nd	X	-		X	-																							
	3rd	X	-		X	-																							
+10	1st	X	-		X	-																							
	2nd	X	-		X	-																							
	3rd	X	-		X	-																							
+5	1st	14	-		14	-																							
	2nd	X	-		X	-																							
	3rd	X	-		X	-																							
GROUND LEVEL	1st	11	-		10	-																							
	2nd	14	-		15	-																							
	3rd	X	-		X	-																							
-5	1st	8	-		8	-																							
	2nd	12	-		14	-																							
	3rd	15	-		X	-																							
-10	1st	5	-		6	-																							
	2nd	9	-		12	-																							
	3rd	12	-		X	-																							
-15	1st	2	-		4	-																							
	2nd	6	-		10	-																							
	3rd	10	-		15	-																							
-20	1st	1	-		2	-																							
	2nd	3	-		8	-																							
	3rd	7	-		13	-																							

TABLE: 5-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 13,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+15	1st	X	X	-	X	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+10	1st	X	X	-	14	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+5	1st	14	X	-	12	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
GROUND LEVEL	1st	11	X	-	10	-																						
	2nd	15	X	-	X	-																						
	3rd	X	X	-	X	-																						
-5	1st	8	X	-	8	-																						
	2nd	12	X	-	14	-																						
	3rd	X	X	-	X	-																						
-10	1st	5	X	-	6	-																						
	2nd	9	X	-	12	-																						
	3rd	13	X	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	X	-	15	-																						
-20	1st	1	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	14	-																						



TABLE: 5-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20		1st	X	X	-	X	X	-	15	-																		
		2nd	X	X	-	X	X	-	X	-																		
		3rd	X	X	-	X	X	-	X	-																		
+15		1st	X	X	-	X	X	-	14	-																		
		2nd	X	X	-	X	X	-	X	-																		
		3rd	X	X	-	X	X	-	X	-																		
+10		1st	X	X	-	14	X	-	12	-																		
		2nd	X	X	-	X	X	-	X	-																		
		3rd	X	X	-	X	X	-	X	-																		
+5		1st	14	X	-	12	15	-	11	-																		
		2nd	X	X	-	X	X	-	X	-																		
		3rd	X	X	-	X	X	-	X	-																		
GROUND LEVEL		1st	11	12	-	10	14	-	10	-																		
		2nd	15	13	-	X	15	-	X	-																		
		3rd	X	15	-	X	X	-	X	-																		
-5		1st	8	8	-	8	8	-	9	-																		
		2nd	12	9	-	14	11	-	15	-																		
		3rd	X	11	-	X	14	-	X	-																		
-10		1st	5	4	-	7	5	-	7	-																		
		2nd	9	5	-	12	8	-	14	-																		
		3rd	13	7	-	X	11	-	X	-																		
-15		1st	2	-	-	5	2	-	6	-																		
		2nd	6	-	-	10	5	-	13	-																		
		3rd	10	3	-	X	8	-	X	-																		
-20		1st	1	-	-	3	X	-	5	-																		
		2nd	3	-	-	8	-	-	11	-																		
		3rd	7	-	-	14	4	-	X	-																		

VOLUME: 19,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 5-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20		1st	X	X	-	X	X	-	15	X	-	13	3L	-	12	-													
		2nd	X	X	-	X	X	-	X	X	-	3L	3½L	-	3L	-													
		3rd	X	X	-	X	X	-	X	X	-	3½L	4L	-	3½L	-													
+15		1st	X	X	-	X	X	-	14	X	-	12	2½L	-	11	-													
		2nd	X	X	-	X	X	-	X	X	-	3L	3L	-	2½L	-													
		3rd	X	X	-	X	X	-	X	X	-	3½L	3½L	-	3½L	-													
+10		1st	X	X	-	15	X	-	13	X	-	11	2½L	-	10	-													
		2nd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	2½L	-													
		3rd	X	X	-	X	X	-	X	X	-	3L	3L	-	3L	-													
+5		1st	X	X	-	13	15	-	11	14	-	10	14	-	10	-													
		2nd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	2½L	-													
		3rd	X	X	-	X	X	-	X	X	-	2½L	2½L	-	3L	-													
GROUND LEVEL		1st	14	12	-	11	12	-	10	12	-	10	14	-	9	-													
		2nd	X	14	-	X	15	-	X	X	-	2L	2L	-	2L	-													
		3rd	X	15	-	X	X	-	X	X	-	2½L	2L	-	2½L	-													
-5		1st	11	8	-	9	9	-	9	9	-	9	10	-	9	-													
		2nd	14	9	-	14	12	-	X	13	-	2L	15	-	2L	-													
		3rd	X	11	-	X	14	-	X	X	-	2L	2L	-	2½L	-													
-10		1st	8	4	-	7	5	-	8	7	-	8	8	-	8	-													
		2nd	12	5	-	13	8	-	14	11	-	15	13	-	2L	-													
		3rd	15	7	-	X	11	-	X	15	-	2L	2L	-	2L	-													
-15		1st	5	1	-	5	2	-	6	5	-	7	6	-	8	-													
		2nd	9	1	-	11	5	-	13	8	-	15	11	-	2L	-													
		3rd	13	3	-	X	8	-	X	12	-	2L	2L	-	2L	-													
-20		1st	2	1	-	3	-	-	5	-	-	6	4	-	7	-													
		2nd	6	1	-	9	1	-	12	5	-	14	9	-	15	-													
		3rd	10	1	-	14	4	-	X	10	-	2L	14	-	2L	-													

VOLUME: 20,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 4 to 6





MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME	220,000 (VEH./DAY)	SPEED	40 (M.P.H.)	%TRUCK	20%	%GRADE	4 to 6
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MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME	(VEH./DAY)	SPEED	40 (M.P.H.)	% TRUCK	20%	% TRUCK	70%TRUCK
3,800							



TABLE: 6-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	11	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	9	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	1	-																									
	2nd	3	-																									
	3rd	7	-																									

VOLUME

5,600

(VEH./DAY)

SPEED

40

(M.P.H.)

%TRUCK

20%

%GRADE

7+

VOLUME 5,600 (VEH./DAY) SPEED 40 (MPH) %TRUCK 20% %GRADE 7+

TABLE: 6-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+15	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+10	1st	X	-	-	14	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+5	1st	14	-	-	12	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
GROUND LEVEL	1st	11	-	-	10	-																						
	2nd	15	-	-	X	-																						
	3rd	X	-	-	X	-																						
-5	1st	8	-	-	8	-																						
	2nd	12	-	-	14	-																						
	3rd	15	-	-	X	-																						
-10	1st	5	-	-	6	-																						
	2nd	9	-	-	12	-																						
	3rd	13	-	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	-	-	X	-																						
-20	1st	1	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	15	-																						

VOLUME 6,400 (VEH./DAY) SPEED 40 (MPH) %TRUCK 20% %GRADE 7+

TABLE: 6-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 13,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	-	X	-	-	15	-	-																			
	2nd	X	X	-	X	-	-	X	-	-																			
	3rd	X	X	-	X	-	-	X	-	-																			
+15	1st	X	X	-	X	-	-	14	-	-																			
	2nd	X	X	-	X	-	-	X	-	-																			
	3rd	X	X	-	X	-	-	X	-	-																			
+10	1st	X	X	-	14	-	-	13	-	-																			
	2nd	X	X	-	X	-	-	X	-	-																			
	3rd	X	X	-	X	-	-	X	-	-																			
+5	1st	14	X	-	12	-	-	12	-	-																			
	2nd	X	X	-	X	-	-	X	-	-																			
	3rd	X	X	-	X	-	-	X	-	-																			
GROUND LEVEL	1st	11	12	-	10	-	-	10	-	-																			
	2nd	15	13	-	X	-	-	X	-	-																			
	3rd	X	15	-	X	-	-	X	-	-																			
-5	1st	8	8	-	8	-	-	8	-	-																			
	2nd	12	9	-	14	-	-	15	-	-																			
	3rd	X	11	-	X	-	-	X	-	-																			
-10	1st	5	4	-	6	-	-	7	-	-																			
	2nd	9	5	-	12	-	-	14	-	-																			
	3rd	13	7	-	X	-	-	X	-	-																			
-15	1st	2	-	-	4	-	-	6	-	-																			
	2nd	6	-	-	10	-	-	12	-	-																			
	3rd	10	3	-	X	-	-	X	-	-																			
-20	1st	-	-	-	3	-	-	5	-	-																			
	2nd	3	-	-	8	-	-	11	-	-																			
	3rd	7	-	-	14	-	-	X	-	-																			

TABLE: 6-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 15,000 (VEH/DAY) SPEED: 40 (MPH) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	X	-	13	-																
	2nd	X	X	-	X	X	-	X	X	-	3L	-																
	3rd	X	X	-	X	X	-	14	X	-	3½L	-																
+15	1st	X	X	-	X	X	-	X	X	-	12	-																
	2nd	X	X	-	X	X	-	X	X	-	3L	-																
	3rd	X	X	-	X	X	-	X	X	-	3½L	-																
+10	1st	X	X	X	14	X	X	13	X	-	11	-																
	2nd	X	X	X	X	X	X	X	X	-	2½L	-																
	3rd	X	X	X	X	X	X	X	X	-	3L	-																
+5	1st	15	15	X	13	15	X	11	14	-	2L	-																
	2nd	X	X	X	X	X	X	X	X	-	2L	-																
	3rd	X	X	X	X	X	X	X	X	-	2½L	-																
GROUND LEVEL	1st	13	X	X	11	12	X	10	12	-	2L	-																
	2nd	X	X	X	X	X	X	X	X	-	2L	-																
	3rd	X	X	X	X	X	X	X	X	-	2½L	-																
-5	1st	9	8	-	9	8	-	9	9	-	9	-																
	2nd	13	9	-	14	11	-	15	13	-	2L	-																
	3rd	X	11	-	X	14	-	X	X	-	2L	-																
-10	1st	6	4	-	7	5	-	8	6	-	8	-																
	2nd	10	5	-	12	8	-	14	11	-	15	-																
	3rd	14	7	-	X	11	-	X	15	-	2L	-																
-15	1st	3	1	-	5	2	-	6	4	-	7	-																
	2nd	7	1	-	10	5	-	13	8	-	14	-																
	3rd	11	3	-	X	8	-	X	12	-	2L	-																
-20	1st	1	1	-	3	-	-	5	-	-	6	-																
	2nd	4	1	-	8	-	-	12	5	-	14	-																
	3rd	8	1	-	14	4	-	X	10	-	2L	-																

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MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 26,000 (VEH/DAY) SPEED 40 (MPH) %TRUCK 20% %GRADE 7+

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	X	X	X	X	X	X	X	13	3L	3L	12	2½L	-	11	-											
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	-	2½L	-											
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3½L	3½L	-	3½L	-											
+15	1st	X	X	X	X	X	X	15	X	X	12	2½L	3L	12	2½L	-	10	-											
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	-	2½L	-											
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	-	3½L	-											
+10	1st	X	X	X	X	X	X	13	X	X	12	2½L	2½L	11	14	-	10	-											
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2L	-											
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	-	2L	-											
+5	1st	X	X	X	X	X	X	12	15	X	11	14	2L	10	13	-	10	-											
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2L	-											
	3rd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	3L	3L	-	2L	-											
GROUND LEVEL	1st	X	12	12	14	12	13	11	12	13	10	12	13	9	11	-	9	-											
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	-	2L	-											
	3rd	X	15	14	X	X	X	X	X	X	2½L	2L	2L	2½L	2½L	-	2L	-											
-5	1st	14	8	8	12	9	9	9	9	9	9	10	10	9	10	-	9	-											
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	2L	-	2L	-											
	3rd	X	11	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	-											
-10	1st	11	4	3	10	6	4	8	7	6	8	8	7	8	9	-	8	-											
	2nd	15	6	4	15	8	6	15	11	10	2L	13	11	2L	15	-	2L	-											
	3rd	X	7	5	X	11	8	X	15	11	2L	2L	15	2L	2L	-	2½L	-											
-15	1st	8	1	-	8	2	-	7	4	2	7	6	4	8	7	-	8	-											
	2nd	12	2	-	14	5	2	13	8	9	15	11	8	2L	13	-	2L	-											
	3rd	X	3	-	X	8	4	X	13	8	2L	2L	12	2L	2L	-	2½L	-											
-20	1st	5	1	-	6	-	-	5	2	-	6	4	-	7	6	-	8	-											
	2nd	9	1	-	12	2	-	12	6	2	14	9	5	2L	12	-	2L	-											
	3rd	13	1	-	X	5	-	X	10	4	2L	15	9	2L	2L	-	2½L	-											

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MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 43,000 (VEH/DAY) SPEED 40 (MPH) %TRUCK 20% %GRADE 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20		1st	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	2½L	10	-								
		2nd	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	-								
		3rd	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	-								
+15		1st	X	X	X	X	X	X	X	X	13	2½L	3L	11	2L	2½L	11	15	2½L	10	-								
		2nd	X	X	X	X	X	X	X	X	2½L	3L	3L	2½L	2½L	3L	2½L	3L	3L	2½L	-								
		3rd	X	X	X	X	X	X	X	X	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-								
+10		1st	X	X	X	X	X	X	X	X	12	2½L	2½L	11	15	2½L	10	14	2L	10	-								
		2nd	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	3L	2½L	2½L	2½L	2½L	-								
		3rd	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	-								
+5		1st	X	X	X	X	X	15	15	X	11	14	2L	10	13	15	10	12	15	9	-								
		2nd	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-								
		3rd	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	-								
GROUND LEVEL		1st	X	13	12	X	14	14	14	13	13	10	12	13	10	12	13	9	11	13	9	-							
		2nd	X	14	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-								
		3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	3L	3L	-							
-5		1st	X	9	8	X	10	9	13	10	10	10	10	10	9	10	11	9	10	11	9	-							
		2nd	X	10	8	X	12	11	X	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	-								
		3rd	X	12	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	2L	-							
-10		1st	14	5	3	14	6	5	11	7	6	9	8	7	9	9	9	9	9	9	-								
		2nd	X	6	4	X	9	6	X	12	10	2L	14	11	2L	15	13	2L	2L	2L	2L	-							
		3rd	X	8	5	X	12	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	-							
-15		1st	11	1	1	12	3	1	10	5	3	8	6	5	8	7	6	8	8	8	8	-							
		2nd	15	2	1	X	6	2	X	9	5	15	12	8	2L	14	11	2L	15	13	2L	-							
		3rd	X	4	1	X	9	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	2L	3L	-							
-20		1st	8	1	1	10	1	1	9	2	1	7	4	2	7	6	4	8	7	6	8	-							
		2nd	11	1	1	15	2	1	15	6	2	15	10	5	15	12	9	2L	14	12	2L	-							
		3rd	X	1	1	X	5	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	-							

TABLE: 6-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																												
		110			170			250			380			570			850			1300			1900			2900				
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW				
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd		
+20	1st	X	X	X	X	X	X	X	X	X	3½L	3L	3½L	13	2½L	3L	11	2½L	3L	10	15	2½L	10	13	2L	-				
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L	-				
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	4	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	4L	-				
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	13	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2L	-				
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	2½L	3L	2½L	3L	3L	2½L	2½L	3L	-				
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-				
+10	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	12	2L	2½L	11	14	2½L	10	13	2½L	9	12	15	-				
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-					
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-				
+5	1st	X	X	X	X	X	X	X	X	X	2½L	2L	2L	12	14	2L	10	13	15	10	12	15	9	12	14	-				
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-				
	3rd	X	X	X	X	X	X	X	X	X	2½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	-				
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	14	14	14	14	11	13	14	10	12	14	9	12	13	9	11	13	-				
	2nd	X	X	14	X	X	15	X	X	X	2L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-				
	3rd	X	X	15	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-				
-5	1st	X	14	8	X	X	10	X	15	10	15	12	11	11	12	10	11	12	9	11	12	9	11	12	-					
	2nd	X	X	9	X	X	11	X	X	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-					
	3rd	X	X	10	X	X	13	X	X	X	3L	2L	12	2L	3L	2½L	2L	3L	3L	3L	3L	3L	3L	3L	-					
-10	1st	X	X	4	X	12	5	X	12	7	14	10	8	10	10	9	9	10	10	9	10	11	9	10	11	-				
	2nd	X	12	5	X	15	7	X	X	10	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-					
	3rd	X	14	6	X	X	9	X	X	12	2½L	2L	2L	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	-				
-15	1st	X	6	1	X	9	1	X	10	3	13	8	5	9	8	7	9	9	8	9	9	9	9	10	10	-				
	2nd	X	8	1	X	12	3	X	14	6	2L	13	9	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	-					
	3rd	X	10	1	X	15	5	X	X	9	2½L	2L	13	2½L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	-				
-20	1st	15	2	1	X	6	1	15	7	1	13	6	2	9	7	5	8	8	7	8	9	8	8	9	9	-				
	2nd	X	4	1	X	9	1	X	11	3	2L	11	6	2L	13	10	2L	15	12	2L	2L	15	2L	2L	-					
	3rd	X	5	1	X	12	1	X	X	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	-				

VOLUME 64,000 (VEH./DAY)

SPEED 40 (MPH)

%TRUCK 20%

%GRADE 7+

VOLUME 64,000 (VEH/DAY) SPEED 40 (M.P.H) %TRUCK: 20% %GRADE: 7+

TABLE: 6-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3L	3L	3L	13	2½L	3L	11	15	2½L	10	14	2L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	4L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	4L
+15	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	3L	12	2½L	2½L	11	14	2½L	10	13	2L	9	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+10	1st	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	2½L	2½L	12	15	2½L	10	14	2½L	10	13	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	2½L	2½L	2L	11	14	2L	10	13	15	10	12	12	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	15	X	X	X	X	X	X	3L	2½L	15	2½L	2L	15	11	13	15	11	12	15	9	12	14	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	4L	3L	2½L	3½L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	10	X	X	12	X	X	13	2½L	2L	13	2½L	15	13	11	12	13	10	11	13	9	11	12	9	11	12
	2nd	X	X	10	X	X	14	X	X	15	3L	2½L	2L	3L	2½L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	12	X	X	15	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3½L	3½L
-10	1st	X	14	6	X	X	8	X	X	9	2½L	2L	10	15	13	10	10	11	11	9	11	11	9	11	12	9	10	12
	2nd	X	X	7	X	X	10	X	X	12	3L	2L	13	3L	2L	15	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	8	X	X	11	X	X	15	3½L	2½L	2L	3½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L
-15	1st	X	10	1	X	14	4	X	X	6	2L	2L	7	15	12	9	10	10	9	9	10	10	9	10	11	9	10	11
	2nd	X	12	2	X	X	6	X	X	8	2½L	2L	11	2½L	2L	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2½L	2½L	
	3rd	X	13	3	X	X	7	X	X	11	3L	2L	14	3L	2L	14	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L
-20	1st	X	6	1	X	11	1	X	13	2	2L	13	4	14	10	6	10	9	7	9	9	9	9	10	10	9	10	10
	2nd	X	8	1	X	14	2	X	X	5	2L	2L	8	2½L	2L	11	2L	2L	13	2L	2L	15	2L	2L	2L	2L	2L	2L
	3rd	X	9	1	X	X	3	X	X	8	2½L	2L	12	3L	2L	15	2½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L

VOLUME 96,000 (VEH./DAY)

SPEED 40 (MPH)

%TRUCK 20%

%GRADE 7+





TABLE: 7-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]

TABLE: 7-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+15	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+10	1st	X	-	-	14	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+5	1st	14	-	-	12	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
GROUND LEVEL	1st	11	-	-	10	-	-																					
	2nd	14	-	-	15	-	-																					
	3rd	X	-	-	X	-	-																					
-5	1st	8	-	-	8	-	-																					
	2nd	12	-	-	9	-	-																					
	3rd	15	-	-	X	-	-																					
-10	1st	5	-	-	6	-	-																					
	2nd	9	-	-	12	-	-																					
	3rd	12	-	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	10	-	-																					
	3rd	0	-	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	7	-	-	13	-	-																					

VOLUME: 6,400 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 7-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-	-																					
	2nd	X	X	-	X	-	-																					
	3rd	X	X	-	X	-	-																					
+15	1st	X	X	-	X	-	-																					
	2nd	X	X	-	X	-	-																					
	3rd	X	X	-	X	-	-																					
+10	1st	X	X	-	14	-	-																					
	2nd	X	X	-	X	-	-																					
	3rd	X	X	-	X	-	-																					
+5	1st	14	X	-	8	-	-																					
	2nd	X	X	-	X	-	-																					
	3rd	X	X	-	X	-	-																					
GROUND LEVEL	1st	11	12	-	10	-	-																					
	2nd	15	13	-	X	-	-																					
	3rd	X	15	-	X	-	-																					
-5	1st	8	8	-	5	-	-																					
	2nd	12	9	-	14	-	-																					
	3rd	X	11	-	X	X	X																					
-10	1st	5	3	-	6	-	-																					
	2nd	9	5	-	12	-	-																					
	3rd	13	7	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	7	-	-																					
	3rd	10	3	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	7	-	-	14	-	-																					

VOLUME: 13,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 7-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	X	X	-	X	-																			
+15	1st	X	X	-	X	X	-	14	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	X	X	-	X	-																			
+10	1st	X	X	-	X	X	-	12	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	X	X	-	X	-																			
+5	1st	15	XX	-	12	15	-	11	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	14	X	-	X	-																			
GROUND LEVEL	1st	12	12	-	10	12	-	10	-																			
	2nd	15	13	-	X	15	-	X	-																			
	3rd	X	15	-	X	X	-	X	-																			
-5	1st	9	8	-	8	8	-	8	-																			
	2nd	13	9	-	14	11	-	X	-																			
	3rd	X	11	-	X	14	-	X	-																			
-10	1st	6	4	-	7	5	-	7	-																			
	2nd	10	5	-	12	8	-	14	-																			
	3rd	14	7	-	X	11	-	X	-																			
-15	1st	4	1	-	5	2	-	6	-																			
	2nd	7	1	-	10	5	-	13	-																			
	3rd	11	3	-	X	10	-	X	-																			
-20	1st	1	1	-	3	-	-	5	-																			
	2nd	5	1	-	8	-	-	11	-																			
	3rd	8	1	-	14	4	-	X	-																			

VOLUME: 19,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 7-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	-	15	X	-	13	-																
	2nd	X	X	X	X	X	-	X	X	-	3L	-																
	3rd	X	X	X	X	X	-	X	X	-	3½L	-																
+15	1st	X	X	X	X	X	-	14	X	-	12	-																
	2nd	X	X	X	X	X	-	X	X	-	3L	-																
	3rd	X	X	X	X	X	-	X	X	-	3½L	-																
+10	1st	X	X	X	15	X	-	13	X	-	11	-																
	2nd	X	X	X	X	X	-	X	X	-	2½L	-																
	3rd	X	X	X	X	X	-	X	X	-	3L	-																
+5	1st	X	X	X	13	15	-	11	14	-	10	-																
	2nd	X	X	X	X	X	-	X	X	-	2L	-																
	3rd	X	X	X	X	X	-	X	X	-	2½L	-																
GROUND LEVEL	1st	15	12	12	11	12	-	10	12	-	10	-																
	2nd	X	14	13	X	15	-	X	X	-	2L	-																
	3rd	X	15	9	X	X	-	X	X	-	2½L	-																
-5	1st	13	8	8	9	8	-	9	9	-	9	-																
	2nd	X	10	8	14	12	-	15	13	-	2L	-																
	3rd	X	11	9	X	14	-	X	X	-	2L	-																
-10	1st	9	4	3	7	5	-	7	6	-	8	-																
	2nd	13	5	4	13	8	-	14	11	-	15	-																
	3rd	X	7	5	X	11	-	X	15	-	2L	-																
-15	1st	7	1	-	5	2	-	6	4	-	7	-																
	2nd	10	1	-	11	5	-	13	8	-	2L	-																
	3rd	14	2	-	X	8	-	X	12	-	2L	-																
-20	1st	4	1	-	3	1	-	5	-	-	6	-																
	2nd	8	1	-	9	1	-	12	5	-	7	-																
	3rd	12	1	-	14	4	-	X	10	-	2L	-																

VOLUME: 28,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 0 to 3



TABLE: 7-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	13	3L	3L	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	X	X	X	12	2½L	3L	11	2½L	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	3L	3L	2½L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	13	X	X	2L	2½L	2½L	11	15	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	12	15	X	11	14	2L	10	13	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	14	12	13	11	12	13	10	12	13	9	11	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	2L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-5	1st	15	8	8	12	9	9	9	9	9	9	10	10	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	9	X	12	10	X	14	12	2L	15	14	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	12	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-10	1st	12	4	3	11	6	4	8	7	6	8	8	7	8	9	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	6	4	15	8	6	15	11	9	2L	13	11	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	11	8	X	15	11	2L	2L	15	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-15	1st	10	1	1	8	2	-	7	4	2	7	6	4	8	7	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	14	1	1	14	5	2	13	8	5	15	11	8	2L	13	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	4	1	X	8	4	X	13	8	2L	2L	12	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-20	1st	7	1	1	7	1	-	5	2	-	6	4	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	11	1	1	12	2	-	12	6	2	14	9	5	15	12	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	15	1	1	X	5	-	X	10	4	2L	15	9	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-

VOLUME 43,000 (VEH./DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 7-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	15	3L	3½L	12	2½L	3L	11	2½L	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	-							
+15	1st	X	X	X	X	X	X	X	X	X	14	2½L	3L	12	2½L	2½L	11	2L	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-							
+10	1st	X	X	X	X	X	X	X	X	X	13	2½L	2½L	11	15	2½L	10	14	2L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	-							
+5	1st	X	X	X	X	X	X	X	X	X	12	15	2L	11	14	2L	10	13	15	9	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	-							
GROUND LEVEL	1st	X	14	12	X	X	13	X	13	13	11	13	13	10	12	13	10	12	13	9	-							
	2nd	X	X	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	-							
	3rd	X	X	14	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	-							
-5	1st	X	11	8	X	10	9	15	10	10	10	11	11	9	11	11	9	11	11	9	-							
	2nd	X	12	9	X	13	11	X	15	13	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	-							
	3rd	X	13	10	X	X	12	X	X	15	2½L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	-							
-10	1st	X	6	3	X	7	5	13	8	6	10	9	8	9	9	9	9	10	10	9	-							
	2nd	X	8	4	X	10	7	X	12	9	2L	14	11	2L	15	14	2L	2L	15	2L	-							
	3rd	X	9	5	X	13	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	-							
-15	1st	14	3	1	15	5	1	12	5	3	9	7	5	8	8	6	8	8	8	8	-							
	2nd	X	5	1	X	7	3	X	9	6	2L	12	9	2L	14	11	2L	2L	14	2L	-							
	3rd	X	5	1	X	10	4	X	14	8	2L	2L	12	2L	2L	2L	2L	2L	2L	2L	-							
-20	1st	10	1	1	13	1	1	11	3	1	8	5	2	8	6	4	8	7	6	8	-							
	2nd	14	1	1	X	3	1	X	7	2	15	10	6	2L	13	9	2L	14	12	2L	-							
	3rd	X	2	1	X	6	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	-							

TABLE: 7-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	3 1/2 L	13	2 1/2 L	3 L	11	2 L	3 L	10	15	2 1/2 L	10	13	2 L	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	3 1/2 L	3 L	3 1/2 L	3 1/2 L	3 L	3 L	3 1/2 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4 1/2 L	4 L	4 L	4 L	4 L	4 L	3 1/2 L	3 1/2 L	4 L	3 1/2 L	3 1/2 L	4 L	3 1/2 L	3 1/2 L	4 L	-	-	-
+15	1st	X	X	X	X	X	X	X	X	X	3 L	3 L	3 L	13	2 1/2 L	3 L	11	15	2 1/2 L	10	14	2 1/2 L	10	13	2 L	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	3 L	3 L	3 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	-	-	-
+10	1st	X	X	X	X	X	X	X	X	X	3 L	2 1/2 L	2 1/2 L	12	2 L	2 1/2 L	11	14	2 1/2 L	10	13	2 L	9	12	15	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3 1/2 L	3 1/2 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	-	-	-	
	3rd	X	X	X	X	X	X	X	X	X	4 L	3 L	3 L	3 1/2 L	3 1/2 L	3 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	-	-	-	
+5	1st	X	X	X	X	X	X	X	X	X	2 1/2 L	2 L	2 L	12	14	2 L	10	13	15	10	12	15	9	12	14	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	-	-	-		
	3rd	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	2 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	-	-	-	
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	14	2 1/2 L	14	14	11	13	14	10	12	14	9	12	13	9	11	13	-	-	-
	2nd	X	X	14	X	X	15	X	X	15	3 L	2 L	2 L	2 1/2 L	2 L	2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	-	-	-		
	3rd	X	X	X	X	X	X	X	X	X	3 1/2 L	2 1/2 L	2 L	3 L	2 1/2 L	2 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	-	-	-		
-5	1st	X	15	8	X	X	X	X	15	10	15	12	11	11	11	12	10	11	12	9	11	12	9	11	12	-	-	-
	2nd	X	X	9	X	X	11	X	X	13	2 1/2 L	2 L	15	2 1/2 L	2 L	2 L	2 L	2 L	2 1/2 L	2 1/2 L	2 L	2 L	2 1/2 L	-	-	-		
	3rd	X	X	10	X	X	13	X	X	X	3 L	2 L	2 L	3 L	2 1/2 L	2 L	3 L	2 1/2 L	2 1/2 L	3 L	3 L	3 L	3 L	-	-	-		
-10	1st	X	11	4	X	12	5	X	15	7	14	10	8	10	10	9	9	10	10	9	10	11	9	10	11	-	-	-
	2nd	X	12	5	X	15	7	X	X	10	2 1/2 L	15	12	2 L	2 L	14	2 L	2 L	2 L	2 L	2 L	2 L	2 L	-	-	-		
	3rd	X	14	6	X	9	X	X	12	3 L	2 L	2 L	2 1/2 L	2 L	2 L	3 L	2 1/2 L	2 1/2 L	3 L	3 L	2 1/2 L	3 L	3 L	-	-	-		
-15	1st	X	6	1	X	9	1	X	10	3	13	8	5	9	8	7	9	9	8	9	9	9	9	10	10	-	-	-
	2nd	X	8	1	X	12	3	X	14	6	2 L	13	9	2 L	15	12	2 L	2 L	14	2 L	2 L	2 L	2 L	-	-	-		
	3rd	X	10	1	X	15	5	X	X	9	2 1/2 L	2 L	13	2 1/2 L	2 L	2 L	2 1/2 L	2 1/2 L	2 L	3 L	2 1/2 L	2 1/2 L	3 L	3 L	-	-	-	
-20	1st	15	3	1	X	6	1	15	7	1	13	6	2	9	7	5	8	8	7	8	9	8	8	9	9	-	-	-
	2nd	X	4	1	X	9	1	X	11	3	2 L	11	6	2 L	13	10	2 L	15	12	2 L	2 L	15	2 L	2 L	-	-	-	
	3rd	X	5	1	X	12	1	X	X	5	2 L	2 L	10	2 1/2 L	2 L	14	1 1/2 L	2 L	2 L	3 L	2 1/2 L	2 1/2 L	3 L	3 L	2 1/2 L	-	-	-

VOLUME 90,000 (VEH/DAY)

SPEED 50 (MPH)

% TRUCK 10%

% GRADE 0 to

VOLUME 96,000 (VEH/DAY)

SPEED 50 (MPH)

%TRUCK 10%

%GRADE: 0 to 3

TABLE: 7-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4 1/2 L	4 1/2 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	15	2 1/2 L	3 L	11	2 L	2 1/2 L	10	14	2 1/2 L	10	13	2 L
	2nd	X	X	X	X	X	X	X	X	X	5 L	4 1/2 L	4 L	4 1/2 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 L	3 L	3 1/2 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L	
	3rd	X	X	X	X	X	X	X	X	X	5 1/2 L	5 L	4 1/2 L	5 L	4 1/2 L	4 L	4 L	4 L	4 L	3 1/2 L	4 L	4 L	3 1/2 L	3 1/2 L	4 L	3 1/2 L	3 1/2 L	4 L
+15	1st	X	X	X	X	X	X	X	X	X	4 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 L	15	2 1/2 L	2 1/2 L	11	15	2 1/2 L	10	13	2 L	10	12	2 L
	2nd	X	X	X	X	X	X	X	X	X	4 1/2 L	4 1/2 L	4 L	4 L	4 L	3 1/2 L	3 1/2 L	3 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L	2 1/2 L	2 1/2 L	3 L
	3rd	X	X	X	X	X	X	X	X	X	5 L	4 1/2 L	4 L	4 1/2 L	4 1/2 L	4 L	4 L	4 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L
+10	1st	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	3 L	3 L	3 L	2 1/2 L	15	2 L	2 1/2 L	11	14	2 L	10	13	2 L	9	12	15
	2nd	X	X	X	X	X	X	X	X	X	4 1/2 L	4 L	3 L	4 L	3 1/2 L	3 L	3 L	3 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L
	3rd	X	X	X	X	X	X	X	X	X	5 L	4 1/2 L	3 1/2 L	4 1/2 L	4 L	3 1/2 L	4 L	3 1/2 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L
+5	1st	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	2 1/2 L	3 L	3 L	2 1/2 L	14	15	2 L	10	13	2 L	10	12	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	3 L	2 1/2 L	3 1/2 L	2 1/2 L	3 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L
	3rd	X	X	X	X	X	X	X	X	X	4 1/2 L	4 L	3 L	4 1/2 L	4 L	3 L	4 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	2 L	3 L	2 1/2 L	2 L	14	14	15	10	13	14	10	12	14	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	2 L	3 1/2 L	3 L	2 1/2 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L
	3rd	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	2 1/2 L	4 L	3 1/2 L	3 L	3 1/2 L	3 L	3 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L	3 1/2 L
-5	1st	X	X	X	X	X	X	X	X	X	3 L	2 1/2 L	2 L	3 L	2 1/2 L	14	13	13	13	10	12	13	9	11	13	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	3 1/2 L	3 L	2 L	3 L	3 L	2 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	3 L	2 1/2 L	2 1/2 L	2 1/2 L
	3rd	X	X	X	X	X	X	X	X	X	4 L	3 1/2 L	2 1/2 L	4 L	3 1/2 L	2 1/2 L	4 L	3 L	3 L	3 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L	3 1/2 L	3 1/2 L
-10	1st	X	X	8	X	X	11	X	X	13	3 L	2 1/2 L	15	2 1/2 L	2 1/2 L	12	13	12	12	10	11	12	9	11	12	9	11	12
	2nd	X	X	9	X	X	13	X	X	X	3 1/2 L	2 1/2 L	2 L	3 1/2 L	3 L	2 L	3 L	2 1/2 L	2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L	2 1/2 L
	3rd	X	X	10	X	X	15	X	X	X	4 L	3 L	2 L	4 L	3 1/2 L	2 L	3 1/2 L	3 L	2 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L	3 L
-15	1st	X	12	4	X	X	7	X	X	10	2 1/2 L	2 L	10	2 1/2 L	2 1/2 L	9	13	13	10	9	10	10	9	10	11	9	10	11
	2nd	X	14	5	X	X	9	X	X	13	3 L	2 L	14	3 L	2 1/2 L	14	3 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 1/2 L	2 1/2 L
	3rd	X	15	5	X	X	11	X	X	15	3 1/2 L	2 1/2 L	2 L	3 1/2 L	3 L	2 L	3 1/2 L	3 L	2 L	3 L	3 L	2 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L
-20	1st	X	8	1	X	13	3	X	X	6	2 L	2 L	7	2 L	15	7	12	12	8	9	10	9	9	10	10	9	10	11
	2nd	X	10	1	X	5	X	X	X	9	2 1/2 L	2 L	11	3 L	2 1/2 L	12	2 1/2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L	2 L
	3rd	X	11	2	X	X	7	X	X	12	3 L	2 L	15	3 1/2 L	3 L	2 L	3 1/2 L	2 1/2 L	2 L	3 L	2 1/2 L	2 1/2 L	3 L	3 L	3 L	3 L	3 L	3 L

VOLUME 140,000 (VEH./DAY)

SPEED 50 (MPH)

% TRUCK: 10%

% GRADE: 0 TO 10

TABLE: 7-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5L	5L	4½L	4½L	4½L	4½L	3½L	3½L	3½L	15	2½L	3L	11	15	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	5L	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	2½L	3L	3L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5½L	5½L	5L	5L	5L	5L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L
+15	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4L	4½L	4L	3½L	3½L	3½L	15	2½L	2½L	11	14	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4L	4L	4L	4L	3½L	3L	3½L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	5L	4½L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L
+10	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3L	3½L	3L	14	2½L	2½L	11	14	2L	10	13	15
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	4L	4L	3½L	3L	3L	2½L	3L	3L	2½L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5½L	5L	4½L	5L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	3½L	3½L	3L	3L	3L	14	2L	2L	10	13	2L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	3½L	3½L	4L	4L	3½L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	5L	4L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	3L	3L	2½L	14	15	2L	10	13	15	10	12	14
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	4L	3½L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	5L	4½L	4L	4½L	4½L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	3½L	3½L	3L	3L	3L	2½L	14	15	15	10	12	14	9	12	13
	2nd	X	X	X	X	X	X	X	X	X	4½L	3½L	3½L	4L	4L	3½L	4L	3½L	3L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3L	5L	4½L	3½L	4½L	4½L	3½L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
-10	1st	X	X	12	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	3L	3L	2½L	13	14	13	10	12	13	9	11	13
	2nd	X	X	13	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3L	3L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	14	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3½L	4½L	4L	3½L	4L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L
-15	1st	X	X	7	X	X	13	X	X	X	3½L	2½L	2L	3L	3L	2L	3L	2½L	2L	13	13	12	10	11	12	9	11	12
	2nd	X	X	8	X	X	14	X	X	X	4L	2½L	2L	4L	3½L	2½L	3½L	3½L	2½L	3L	3L	2L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	9	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3L	4½L	4L	3L	3½L	3½L	3L	3½L	3L	3L	3½L	3½L	3L
-20	1st	X	13	4	X	X	9	X	X	13	3L	3L	2L	3L	2½L	2L	2½L	2½L	2L	13	12	11	9	11	11	9	10	11
	2nd	X	15	5	X	X	10	X	X	X	3½L	2½L	2L	3½L	3L	2½L	3½L	3L	2½L	3L	2½L	2L	2½L	2½L	2L	2½L	2½L	2½L
	3rd	X	X	5	X	X	12	X	X	X	4L	3L	2L	4½L	3½L	2½L	4L	4L	14	4L	3½L	2½L	3L	3L	3L	3L	3L	3L

VOLUME: 220,000 (VEH/DAY)

SPEED: 50 (M.P.H.)

%TRUCK: 10%

%GRADE: 0 to 3

TABLE: 8-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
+15	1st	X	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
+10	1st	X	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
+5	1st	13	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
GROUND LEVEL	1st	10	-	-																								
	2nd	14	-	-																								
	3rd	X	-	-																								
-5	1st	8	-	-																								
	2nd	11	-	-																								
	3rd	15	-	-																								
-10	1st	5	-	-																								
	2nd	8	-	-																								
	3rd	12	-	-																								
-15	1st	2	-	-																								
	2nd	6	-	-																								
	3rd	9	-	-																								
-20	1st	-	-	-																								
	2nd	3	-	-																								
	3rd	6	-	-																								

VOLUME  
3,500  
(VEH./DAY)

SPEED: 50 (M.P.H.)

%TRUCK: 10%

%GRADE: 4.1%

VOLUME: 3,600 (VEH/DAY)

SPEED: 50 (M.P.H.)

%TRUCK: 10%

%GRADE: 4 to 6

TABLE: 8-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	-	-																									
	2nd	X	-	-																									
	3rd	X	-	-																									
+15	1st	X	-	-																									
	2nd	X	-	-																									
	3rd	X	-	-																									
+10	1st	X	-	-																									
	2nd	X	-	-																									
	3rd	X	-	-																									
+5	1st	13	-	-																									
	2nd	X	-	-																									
	3rd	X	-	-																									
GROUND LEVEL	1st	11	-	-																									
	2nd	14	-	-																									
	3rd	X	-	-																									
-5	1st	8	-	-																									
	2nd	11	-	-																									
	3rd	15	-	-																									
-10	1st	5	-	-																									
	2nd	9	-	-																									
	3rd	12	-	-																									
-15	1st	2	-	-																									
	2nd	6	-	-																									
	3rd	9	-	-																									
-20	1st	1	-	-																									
	2nd	3	-	-																									
	3rd	7	-	-																									

VOLUME  
F,600  
(VEH./DAY)

SPEED: 50  
(M.P.H.)

%TRUCK: 10%

%GRADE: 4 to

VOLUME: 5,600 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 8-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+15	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+10	1st	X	-	-	14	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+5	1st	14	-	-	12	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
GROUND LEVEL	1st	11	-	-	10	-	-																					
	2nd	15	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
-5	1st	8	-	-	8	-	-																					
	2nd	12	-	-	14	-	-																					
	3rd	15	-	-	X	-	-																					
-10	1st	5	-	-	6	-	-																					
	2nd	9	-	-	12	-	-																					
	3rd	13	-	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	10	-	-																					
	3rd	10	-	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	6	-	-	13	-	-																					

VOLUME: 8,400 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 4 to 6



TABLE: 8-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-	-	15	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+15	1st	X	X	-	X	-	-	14	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+10	1st	X	X	-	14	-	-	12	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+5	1st	14	X	-	12	-	-	11	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
GROUND LEVEL	1st	11	12	-	10	-	-	10	-	-																		
	2nd	15	13	-	X	-	-	X	-	-																		
	3rd	X	15	-	X	-	-	X	-	-																		
-5	1st	8	8	-	10	-	-	8	-	-																		
	2nd	12	9	-	X	-	-	15	-	-																		
	3rd	X	11	-	X	-	-	X	-	-																		
-10	1st	5	4	-	6	-	-	7	-	-																		
	2nd	9	5	-	12	-	-	14	-	-																		
	3rd	13	7	-	X	-	-	X	-	-																		
-15	1st	2	-	-	4	-	-	6	-	-																		
	2nd	6	-	-	10	-	-	12	-	-																		
	3rd	10	3	-	X	-	-	X	-	-																		
-20	1st	1	-	-	3	-	-	5	-	-																		
	2nd	3	-	-	8	-	-	11	-	-																		
	3rd	7	-	-	14	-	-	X	-	-																		

VOLUME 13,000 (VEH/DAY)

SPEED 50 (MPH)

%TRUCK: 10%

%GRADE: 4 to 6

VOLUME 13,000 (VEH/DAY) SPEED 50 (M.P.H.) %TRUCK 10% %GRADE 4 to 6

TABLE: 8-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	-	-	13	2L	2L	-														
	2nd	X	X	-	X	X	-	X	-	-	3L	2L	2L	-														
	3rd	X	X	-	X	X	-	X	-	-	3½L	2L	2L	-														
+15	1st	X	X	-	X	X	-	14	-	-	12	2L	2L	-														
	2nd	X	X	-	X	X	-	X	-	-	3L	2L	2L	-														
	3rd	X	X	-	X	X	-	X	-	-	3½L	2L	2L	-														
+10	1st	X	X	-	14	X	-	12	-	-	11	2L	2L	-														
	2nd	X	X	-	X	X	-	X	-	-	2½L	2L	2L	-														
	3rd	X	X	-	X	X	-	X	-	-	3L	2L	2L	-														
+5	1st	15	X	-	13	15	-	11	-	-	10	2L	2L	-														
	2nd	X	X	-	X	X	-	X	-	-	2L	2L	2L	-														
	3rd	X	X	-	X	X	-	X	-	-	2½L	2L	2L	-														
GROUND LEVEL	1st	12	12	-	11	12	-	10	-	-	9	2L	2L	-														
	2nd	15	13	-	X	15	-	X	-	-	2L	2L	2L	-														
	3rd	X	15	-	X	X	-	X	-	-	2½L	2L	2L	-														
-5	1st	9	8	-	9	12	-	9	-	-	9	-	-	-														
	2nd	13	13	-	14	11	-	15	-	-	2L	-	-	-														
	3rd	X	X	-	X	13	-	X	-	-	2L	-	-	-														
-10	1st	6	4	-	7	5	-	7	-	-	8	-	-	-														
	2nd	10	5	-	12	8	-	14	-	-	15	-	-	-														
	3rd	14	7	-	X	11	-	X	-	-	2L	-	-	-														
-15	1st	3	1	-	5	2	-	6	-	-	7	-	-	-														
	2nd	7	1	-	10	5	-	13	-	-	14	-	-	-														
	3rd	11	3	-	X	8	-	X	-	-	2L	-	-	-														
-20	1st	1	1	-	3	-	-	5	-	-	6	-	-	-														
	2nd	5	1	-	8	-	-	11	-	-	13	-	-	-														
	3rd	8	1	-	14	4	-	X	-	-	2L	-	-	-														

VOLUME  
19,000 (VEH./DAY)  
SPEED 50 (MPH)  
%TRUCK 10%  
%GRADE 4 TO 6

VOLUME 19,000 (VEH/DAY) SPEED 50 (M.P.H.) %TRUCK 10% %GRADE 4 to 6

TABLE: 8-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 28,000 (VEH/DAY) SPEED 50 (MPH) %TRUCK 10% %GRADE: 4 to 6

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	-	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	-	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	-	-												
+15	1st	X	X	X	X	X	X	14	X	-	12	3L	-	11	-	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	-	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	-	-												
+10	1st	X	X	X	15	X	X	13	X	-	11	2L	-	10	-	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	-	-												
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	-	-												
+5	1st	X	X	X	13	15	X	11	14	-	10	14	-	10	-	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	-	-												
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	-	-												
GROUND LEVEL	1st	15	12	12	12	12	12	10	12	-	10	12	-	9	-	-												
	2nd	X	14	13	X	15	14	X	X	-	2L	2L	-	2L	-	-												
	3rd	X	15	14	X	X	X	X	X	-	2½L	2L	-	2½L	-	-												
-5	1st	12	8	8	10	9	8	9	9	-	9	10	-	9	-	-												
	2nd	X	10	8	15	12	10	X	13	-	2L	15	-	2L	-	-												
	3rd	X	11	9	X	15	12	X	X	-	2L	2L	-	2½L	-	-												
-10	1st	9	4	3	8	5	4	8	7	-	8	8	-	8	-	-												
	2nd	13	5	4	13	8	6	14	11	-	15	13	-	2L	-	-												
	3rd	X	7	5	X	11	8	X	15	-	2L	2L	-	2L	-	-												
-15	1st	7	1	-	6	2	-	6	4	-	7	6	-	8	-	-												
	2nd	10	1	-	11	5	2	13	8	-	15	11	-	2L	-	-												
	3rd	14	3	-	X	8	4	X	12	-	2L	2L	-	2L	-	-												
-20	1st	4	1	-	4	1	-	5	-	-	6	4	-	7	-	-												
	2nd	8	1	-	9	2	-	12	5	-	14	9	-	2L	-	-												
	3rd	12	1	-	15	5	-	X	10	-	2L	14	-	2L	-	-												

TABLE: 8-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 43,000 (VEH/DAY) SPEED 50 (MPH) %TRUCK 10% %GRADE: 4 to 6

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	2L	12	2½L	3L	11	2½L	-									
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	2L	3L	3L	3½L	2½L	3L	-									
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3L	3½L	3½L	4L	3½L	3½L	-									
+15	1st	X	X	X	X	X	X	13	X	X	13	2½L	3L	11	2½L	2½L	10	14	-									
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	-									
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-									
+10	1st	X	X	X	X	X	X	14	X	X	12	2½L	2½L	11	15	2½L	10	13	-									
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-									
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3L	3½L	-									
+5	1st	X	X	X	X	X	X	13	15	X	11	14	2L	10	13	15	10	12	-									
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-									
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	-									
GROUND LEVEL	1st	X	12	12	X	12	13	11	12	13	10	12	13	10	12	13	2L	2L	-									
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	-									
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	2½L	2½L	2½L	3L	3L	-									
-5	1st	15	8	8	14	9	9	10	10	9	9	8	7	9	10	8	9	10	-									
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	2L	2L	2L	2L	-									
	3rd	X	12	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	-									
-10	1st	12	4	3	X	6	5	9	7	6	8	8	7	8	9	8	9	9	-									
	2nd	X	6	4	X	9	6	15	11	10	2L	13	11	2L	15	13	2L	2L	-									
	3rd	X	8	5	X	12	4	X	X	11	2L	2L	15	2½L	2L	2L	2½L	2½L	-									
-15	1st	10	1	1	10	2	1	7	4	3	8	6	4	8	7	6	8	8	-									
	2nd	14	1	1	15	5	2	14	9	5	15	11	8	2L	14	11	2L	15	-									
	3rd	15	1	1	X	8	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	-									
-20	1st	7	1	1	8	1	1	6	2	-	7	4	1	7	6	4	8	7	-									
	2nd	11	1	1	14	1	1	13	6	2	14	9	5	15	12	9	2L	14	-									
	3rd	15	1	1	X	5	1	X	10	4	2L	15	9	2L	2L	14	2½L	2L	-									

TABLE: 8-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3L	3L	3½L	13	2½L	3L	11	2½L	2½L	10	14	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3½L	3½L	3L	3½L	3½L	3L	3½L	2½L	3L	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	4L	4L	3½L	4L	4L	3L	4L	3L	3½L	-	-	-	-	-
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	12	2½L	11	15	2½L	11	15	2½L	10	14	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	3L	2½L	2½L	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-	-	-
+10	1st	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	11	15	2½L	10	14	2L	10	13	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	X	X	X	15	15	2L	11	14	2L	10	13	15	9	12	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	X	13	X	X	13	X	14	14	14	13	14	10	12	14	10	12	13	9	11	-	-	-	-	-	-	-
	2nd	X	X	14	X	X	15	X	X	X	2½L	2L	2L	2½L	2L	2L	2L	2½L	2½L	2½L	2½L	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	-	-	-	-	-	-	-	-
-5	1st	X	12	8	X	13	9	X	12	10	13	11	11	10	11	11	9	11	11	9	8	-	-	-	-	-	-	-
	2nd	X	14	8	X	X	11	X	X	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	-	-	-	-	-	-	-	-
	3rd	X	X	10	X	X	13	X	X	X	2½L	2L	2L	2½L	2L	2L	2L	2½L	2½L	3L	3L	-	-	-	-	-	-	-
-10	1st	X	8	4	X	10	5	15	9	7	12	9	8	9	9	9	9	10	10	9	8	-	-	-	-	-	-	-
	2nd	X	10	4	X	13	7	X	13	10	2L	14	12	2L	2L	14	2L	2L	2L	2L	-	-	-	-	-	-	-	-
	3rd	X	12	5	X	9	X	X	12	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2L	3L	3L	-	-	-	-	-	-	-
-15	1st	15	4	1	X	6	1	14	6	3	11	9	5	9	8	7	8	8	8	8	9	-	-	-	-	-	-	-
	2nd	X	6	1	X	9	3	X	10	6	2L	12	9	2L	2L	12	2L	2L	14	2L	-	-	-	-	-	-	-	-
	3rd	X	8	1	X	12	5	X	15	9	2L	2L	13	2L	2L	2L	2½L	2½L	2L	3L	-	-	-	-	-	-	-	-
-20	1st	13	1	1	14	3	1	13	4	1	10	5	2	8	6	4	8	7	6	8	8	-	-	-	-	-	-	-
	2nd	X	2	1	X	6	1	X	8	2	2L	10	6	2L	13	9	2L	14	12	2L	-	-	-	-	-	-	-	-
	3rd	X	3	1	X	9	1	X	12	5	2L	2L	15	2L	2L	14	2½L	2L	2L	2½L	-	-	-	-	-	-	-	-

VOLUME: 64,000 (VEH./DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 8-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3L	3L	12	2½L	3L	11	15	2½L	10	13	2½L	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	-
+15	1st	X	X	X	X	X	X	X	X	X	3½L	3L	3L	2½L	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2L	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+10	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	15	3L	3L	11	15	2½L	10	13	2L	9	12	15	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2L	14	15	2L	11	14	2L	10	13	15	9	23	14	9	11	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	3½L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	15	2½L	2L	15	14	14	10	12	14	10	12	14	9	11	13	9	11	-	-
	2nd	X	X	14	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	15	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-
-5	1st	X	X	9	X	X	10	X	X	11	2½L	2L	12	13	12	12	10	11	12	9	11	12	9	11	12	9	10	-
	2nd	X	X	10	X	X	12	X	X	14	3L	2L	15	2½L	2L	2L	2L	2L	2½L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	11	X	X	14	X	X	X	3½L	2½L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-
-10	1st	X	12	4	X	15	6	X	X	8	2L	14	2L	13	11	10	10	10	10	9	10	11	9	10	11	9	10	-
	2nd	X	14	5	X	X	8	X	X	10	2½L	2L	13	2½L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-
	3rd	X	15	6	X	X	5	X	X	13	3L	2L	2L	3L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	-
-15	1st	X	8	1	X	11	2	X	13	4	2L	12	6	12	9	7	9	9	9	9	10	14	9	10	10	9	9	-
	2nd	X	10	1	X	14	4	X	X	7	2L	2L	10	2L	2L	12	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-
	3rd	X	11	1	X	X	5	X	X	10	2½L	2L	11	3L	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	-
-20	1st	X	4	1	X	8	1	X	10	1	15	10	3	12	8	5	9	8	7	9	9	6	9	9	9	6	9	-
	2nd	X	6	1	X	11	1	X	15	3	2L	15	7	2L	14	10	2L	15	13	2L	2L	15	2L	2L	2L	2L	2L	-
	3rd	X	7	1	X	15	1	X	X	6	2½L	2L	11	2½L	2L	15	2½L	2L	2L	2½L	2½L	2½L	3L	3L	2½L	3L	3L	-



TABLE: 8-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											VOLUME 140,000 (VEH/DAY)	SPEED 50 (MPH)	%TRUCK 10%	%GRADE 4 to
		110			170			250			380			570			850			1300			1900			2900						
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd				
+20	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4½L	4L	4L	3L	3L	3L	12	2½L	2½L	10	14	2½L	10	13	2L					
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	4½L	4½L	4L	4L	4L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L				
	3rd	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	5½L	5L	4½L	4½L	4½L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L				
+15	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3L	3L	12	2L	2½L	10	14	2L	10	13	2L					
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	3½L	3½L	3L	3L	3½L	3L	3L	3L	3L	2½L	2½L	3L				
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4½L	4½L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	3½L				
+10	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3½L	3½L	3L	3L	3L	2L	11	15	2½L	10	13	2L	10	12	15				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L				
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L				
+5	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	2½L	2½L	2½L	11	14	2L	10	13	15	9	12	14				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	4L	3L	3½L	3½L	3L	2½L	2½L	2½L	3L	2½L	2½L	2½L	2½L	2½L				
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	4½L	4½L	3½L	3½L	4L	3L	2½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L				
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	2½L	2½L	2½L	2L	11	13	15	10	12	14	9	12	14				
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L				
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3L	4L	4L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L				
-5	1st	X	X	15	X	X	X	X	X	X	3½L	3L	2L	3L	3L	2L	2½L	2½L	15	11	13	14	10	12	13	9	11	13				
	2nd	X	X	15	X	X	X	X	X	X	4L	3L	2½L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L				
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4½L	4L	3L	4L	3½L	3L	3½L	3L	3L	3L	3L	3½L	3½L	3½L	3½L				
-10	1st	X	X	10	X	X	14	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2L	13	11	12	12	9	11	12	9	11	12				
	2nd	X	X	10	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L				
	3rd	X	X	12	X	X	X	X	X	X	4L	3L	2L	4L	3½L	2½L	4L	3½L	2½L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L				
-15	1st	X	14	6	X	X	10	X	X	13	2½L	2L	15	2½L	2½L	14	15	2L	11	10	11	11	9	11	11	9	11	12				
	2nd	X	X	7	X	X	12	X	X	X	3L	2½L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2L	2L	2½L	2½L	2L	2½L	2½L	2½L				
	3rd	X	X	7	X	X	14	X	X	X	3½L	2½L	2L	4L	3½L	2L	3½L	3L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L				
-20	1st	X	10	1	X	X	6	X	X	10	2½L	2L	12	2½L	2L	12	15	15	9	10	10	10	9	10	10	9	10	11				
	2nd	X	12	2	X	X	8	X	X	13	3L	2L	2L	3L	2½L	2L	3L	2½L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L				
	3rd	X	14	3	X	X	9	X	X	15	3½L	2½L	2L	3½L	3L	2L	3½L	3L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L				

VOLUME: 140,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 8-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	4½L	5L	5L	4L	4L	4L	3L	3L	3L	12	2L	2½L	10	14	2L	
	2nd	X	X	X	X	X	X	X	X	X	6L	6L	5L	5½L	5½L	5L	4½L	5L	5L	4L	4L	4L	3L	3L	3½L	2½L	3L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6½L	6L	5½L	6L	6L	5L	5½L	5½L	5½L	4½L	5L	4½L	3½L	4L	4L	3½L	3½L	4L	
+15	1st	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	4½L	4½L	4½L	3½L	4L	4L	3L	3L	3L	12	15	2½L	10	13	2L	
	2nd	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5L	5L	5L	4½L	4½L	4½L	3½L	4L	3½L	3L	3L	3L	2½L	2½L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6½L	5½L	5L	6L	5½L	5½L	5½L	5L	4½L	4½L	4½L	4½L	4L	3½L	4L	4L	3½L	3½L	4L
+10	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	3½L	4L	3½L	3L	3L	3L	11	15	2½L	10	13	2L	
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4½L	4½L	4½L	3½L	4L	3½L	2½L	3L	3L	2½L	2½L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	5L	5L	4½L	4½L	4L	3½L	3½L	4L	4L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4L	4L	4L	3½L	3½L	3½L	2½L	3L	2½L	11	14	2L	10	13	15	
	2nd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	4½L	4L	4L	4L	4L	3½L	3½L	3½L	3L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4L	5½L	5L	4½L	5L	5L	4½L	4½L	4½L	4L	3½L	3½L	3½L	3L	3L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3L	2½L	2½L	2½L	11	14	15	10	12	14	
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	3L	2½L	2½L	3L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5½L	5L	4L	5L	5L	4½L	4½L	4½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	15	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3L	3L	3½L	3L	2½L	2½L	2L	11	13	15	10	12	14	
	2nd	X	X	15	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	5L	4½L	4L	5L	4½L	4L	4L	4L	3L	2½L	2½L	2½L	2½L	2½L	2½L	
-10	1st	X	X	14	X	X	X	X	X	X	4L	3L	2½L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	2L	11	13	14	10	12	13	
	2nd	X	X	X	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3L	4L	3½L	3L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3L	5L	4½L	3½L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	3L	3½L	3½L	3½L	
-15	1st	X	X	9	X	X	15	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	2½L	2½L	2½L	15	10	12	13	9	11	12	
	2nd	X	X	10	X	X	X	X	X	X	4L	3L	2L	4L	3½L	3L	3½L	3½L	3L	3L	3L	2L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	11	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3L	4½L	4L	3½L	4L	4L	3L	3½L	3½L	3½L	3L	3½L	3L	
-20	1st	X	X	5	X	X	11	X	X	X	3½L	2½L	2L	3L	3L	2L	3L	2½L	2L	15	2L	14	10	12	12	9	11	12	
	2nd	X	X	6	X	X	13	X	X	X	4L	3L	2L	4L	3½L	2½L	3½L	3½L	2½L	3L	3L	2L	2½L	2½L	2L	2½L	2½L	2½L	
	3rd	X	X	7	X	X	15	X	X	X	4L	3L	2L	4½L	4L	3L	4½L	4L	3L	4L	3½L	3L	3½L	3L	3L	3L	3L	3L	

VOLUME: 220,000 (Veh./Day)

SPEED: 50 MPH

%TRUCK: 10%

%GRADE: 4 to



TABLE: 9-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	-																										
	2nd	X	-																										
	3rd	X	-																										
+15	1st	X	-																										
	2nd	X	-																										
	3rd	X	-																										
+10	1st	X	-																										
	2nd	X	-																										
	3rd	14	-																										
+5	1st	13	-																										
	2nd	X	-																										
	3rd	X	-																										
GROUND LEVEL	1st	10	-																										
	2nd	14	-																										
	3rd	X	-																										
-5	1st	8	-																										
	2nd	11	-																										
	3rd	15	-																										
-10	1st	5	-																										
	2nd	8	-																										
	3rd	12	-																										
-15	1st	2	-																										
	2nd	6	-																										
	3rd	9	-																										
-20	1st	X	-																										
	2nd	3	-																										
	3rd	7	-																										

VOLUME 3,500 (VEH./DAY)

SPEED 50 (M.P.H.)

%TRUCK 10%

%GRADE 7+

VOLUME: 3,600 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 7+

TABLE: 9-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+15	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+10	1st	X	-	-	14	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+5	1st	14	-	-	12	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
GROUND LEVEL	1st	11	-	-	10	-																						
	2nd	14	-	-	15	-																						
	3rd	X	-	-	X	-																						
-5	1st	8	-	-	8	-																						
	2nd	12	-	-	14	-																						
	3rd	15	-	-	X	-																						
-10	1st	5	-	-	6	-																						
	2nd	9	-	-	12	-																						
	3rd	12	-	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	-	-	15	-																						
-20	1st	1	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	13	-																						

VOLUME: 5,600 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 7+

TABLE: 9-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+15	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+10	1st	X	-	-	14	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+5	1st	14	-	-	12	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
GROUND LEVEL	1st	11	-	-	10	-	-																					
	2nd	15	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
-5	1st	8	-	-	8	-	-																					
	2nd	12	-	-	14	-	-																					
	3rd	15	-	-	X	-	-																					
-10	1st	5	-	-	8	-	-																					
	2nd	9	-	-	12	-	-																					
	3rd	13	-	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	10	-	-																					
	3rd	10	-	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	7	-	-	14	-	-																					

VOLUME: 8,400 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 7+

TABLE: 9-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-	-	15	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+15	1st	X	X	-	X	-	-	14	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+10	1st	X	X	-	14	-	-	12	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+5	1st	14	X	-	12	-	-	11	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
GROUND LEVEL	1st	11	12	-	10	-	-	10	-	-																		
	2nd	15	13	-	X	-	-	X	-	-																		
	3rd	X	15	-	X	-	-	X	-	-																		
-5	1st	8	8	-	8	-	-	8	-	-																		
	2nd	12	9	-	14	-	-	15	-	-																		
	3rd	X	11	-	X	-	-	X	-	-																		
-10	1st	5	4	-	6	-	-	7	-	-																		
	2nd	9	5	-	12	-	-	14	-	-																		
	3rd	13	7	-	X	-	-	X	-	-																		
-15	1st	2	-	-	4	-	-	6	-	-																		
	2nd	6	-	-	10	-	-	13	-	-																		
	3rd	10	3	-	X	-	-	X	-	-																		
-20	1st	1	-	-	3	-	-	5	-	-																		
	2nd	3	-	-	8	-	-	11	-	-																		
	3rd	7	-	-	14	-	-	X	-	-																		

VOLUME: 13,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 7+

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	X	-	13	-																
	2nd	X	X	-	X	X	-	X	X	-	3L	-																
	3rd	X	X	-	X	X	-	X	X	-	3½L	-																
+15	1st	X	X	-	X	X	-	14	X	-	12	-																
	2nd	X	X	-	X	X	-	X	X	-	3L	-																
	3rd	X	X	-	X	X	-	X	X	-	3½L	-																
+10	1st	X	X	-	14	X	-	13	X	-	11	-																
	2nd	X	X	-	X	X	-	X	X	-	2½L	-																
	3rd	X	X	-	X	X	-	X	X	-	3L	-																
+5	1st	X	X	-	13	15	-	11	14	-	10	-																
	2nd	X	X	-	X	X	-	X	X	-	2L	-																
	3rd	X	X	-	X	X	-	X	X	-	2½L	-																
GROUND LEVEL	1st	14	12	-	11	12	-	10	12	-	10	-																
	2nd	X	14	-	X	15	-	X	X	-	2L	-																
	3rd	X	15	-	X	X	-	X	X	-	2½L	-																
-5	1st	11	8	-	9	8	-	9	9	-	9	-																
	2nd	14	9	-	14	11	-	15	13	-	2L	-																
	3rd	X	11	-	X	14	-	X	X	-	2L	-																
-10	1st	8	4	-	7	5	-	7	6	-	8	-																
	2nd	12	5	-	12	8	-	14	11	-	15	-																
	3rd	15		-	X	11	-	X	15	-	2L	-																
-15	1st	5	1	-	5	2	-	6	4	-	7	-																
	2nd	9	1	-	10	5	-	13	8	-	14	-																
	3rd	13	3	-	X	8	-	X	12	-	2L	-																
-20	1st	2	1	-	2	1	-	5	-	-	6	-																
	2nd	6	1	-	8	1	-	12	5	-	14	-																
	3rd	10	1	-	14	4	-	X	10	-	2L	-																

VOLUME: 15,000 (VEH./DAY)

SPEED: 50 (M.P.H.)

%TRUCK: 10%

%GRADE: 7+

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+15	1st	X	X	X	X	X	X	14	X	-	12	3L	-	11	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+10	1st	X	X	X	15	X	X	13	X	-	11	2½L	-	11	15	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	3L	-												
+5	1st	X	X	X	13	15	X	12	15	-	11	14	-	10	13	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	3L	-												
GROUND LEVEL	1st	X	12	12	12	12	12	10	12	-	10	12	-	9	11	-												
	2nd	X	14	13	X	15	14	X	X	-	2L	2L	-	2L	2L	-												
	3rd	X	15	14	X	X	X	X	X	-	2½L	2L	-	2½L	2½L	-												
-5	1st	14	8	8	10	9	8	9	9	-	9	10	-	9	10	-												
	2nd	X	10	8	15	12	10	X	14	-	2L	15	-	2L	2L	-												
	3rd	X	11	5	X	15	12	X	X	-	2L	2L	-	2½L	2½L	-												
-10	1st	11	4	3	8	5	3	8	7	-	8	8	-	8	8	-												
	2nd	15	6	4	13	8	6	14	11	-	14	13	-	2L	15	-												
	3rd	X	7	5	X	11	8	X	15	-	2L	2L	-	2L	2L	-												
-15	1st	8	1	-	6	2	-	6	4	-	7	6	-	8	7	-												
	2nd	12	2	-	11	5	2	13	8	-	15	11	-	2L	13	-												
	3rd	X	3	-	X	8	4	X	12	-	2L	2L	-	2L	2L	-												
-20	1st	5	1	-	4	1	-	5	-	-	6	4	-	7	5	-												
	2nd	9	1	-	9	2	-	12	6	-	14	9	-	15	12	-												
	3rd	13	1	-	15	5	-	X	X	-	2L	14	-	2L	2L	-												

TABLE: 9-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	2½L	10	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	X	X	X	13	2½L	3L	11	2½L	2½L	11	15	2½L	10	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	X	X	X	12	15	2½L	11	15	2½L	10	14	2L	10	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	X	X	X	11	14	2L	10	13	2L	10	12	15	9	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	13	12	X	13	13	14	13	13	10	12	13	10	12	13	9	11	13	9	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	3L	3L	-	-	-	-	-	-	-	-
-5	1st	X	9	8	X	10	9	13	10	10	10	10	10	9	10	11	9	10	11	9	-	-	-	-	-	-	-	-
	2nd	X	10	8	X	12	6	X	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	-	-	-	-	-	-	-	-
	3rd	X	12	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2½L	2L	2½L	2½L	3L	-	-	-	-	-	-	-	-
-10	1st	X	5	3	14	6	5	11	7	6	9	8	7	9	9	9	9	9	9	9	-	-	-	-	-	-	-	-
	2nd	X	6	4	X	9	6	X	12	10	2L	14	11	2L	15	13	2L	2L	2L	2L	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	12	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	-	-	-	-	-	-	-	-
-15	1st	11	1	1	12	3	1	10	5	3	8	6	5	8	7	6	8	8	8	8	-	-	-	-	-	-	-	-
	2nd	15	2	1	X	6	2	X	9	5	14	12	8	2L	14	11	2L	15	13	2L	-	-	-	-	-	-	-	-
	3rd	X	4	1	X	9	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	2L	3L	-	-	-	-	-	-	-	-
-20	1st	8	1	1	10	1	1	9	2	1	7	4	2	7	6	4	8	7	6	8	-	-	-	-	-	-	-	-
	2nd	13	1	1	15	2	1	15	6	2	15	10	5	15	12	9	2L	14	12	2L	-	-	-	-	-	-	-	-
	3rd	X	1	1	X	5	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	-	-	-	-	-	-	-	-

VOLUME: 43,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 10% %GRADE: 7+

TABLE: 9-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
		110									170									250									380									570									850									1300									1900									2900																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		



TABLE: 5-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																														VOLUME 96,000 (VEH./DAY)	SPEED 50 (MPH)	% TRUCK 10%	% GRADE 7+
		110			170			250			380			570			850			1300			1900			2900									
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW									
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd				
+20	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3L	3L	3L	13	2½L	3L	11	15	2½L	10	14	2½L	10	13	2L							
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	3½L	3½L	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L							
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	3½L	3½L	4L						
+15	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3L	3L	3L	12	2½L	2½L	11	14	3L	10	13	2L	9	12	15							
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L							
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L					
+10	1st	X	X	X	X	X	X	X	X	X	3½L	3½L	3L	3L	3L	2½L	12	15	2½L	10	14	2L	10	13	15	9	12	14							
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L								
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L					
+5	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	2½L	2½L	2L	11	14	2L	10	13	2L	10	12	14	9	12	14							
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2L	2L	2L						
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	2½L	2½L	2½L						
GROUND LEVEL	1st	X	X	15	X	X	X	X	X	X	3½L	2½L	15	2½L	2L	15	11	13	14	10	12	14	9	12	13	9	11	13							
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L					
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	4L	3L	2½L	3½L	3L	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L					
-5	1st	X	X	10	X	X	12	X	X	15	2½L	2L	13	2½L	15	13	11	12	13	10	11	13	9	11	12	9	11	12							
	2nd	X	X	10	X	X	15	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2L	2L	2L	2L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L					
	3rd	X	X	12	X	X	15	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L					
-10	1st	X	10	1	X	X	8	X	X	9	2½L	2L	10	15	12	10	10	11	11	9	11	11	9	11	12	9	10	12							
	2nd	X	X	7	X	X	10	X	X	12	3L	2L	13	3L	2L	15	2L	2L	2L	2L	2L	2L	2L	2½L	2L	2½L	2½L	2½L							
	3rd	X	X	8	X	X	11	X	X	15	3½L	3½L	2L	3½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L							
-15	1st	X	10	1	X	14	3	X	X	6	2L	2L	7	15	12	9	10	11	9	9	10	10	9	11	11	9	10	11							
	2nd	X	12	2	X	X	6	X	X	8	2½L	2L	11	2½L		2L	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2½L	2½L						
	3rd	X	13	3	X	X	7	X	X	11	3L	2L	14	3L	2L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L							
-20	1st	X	6	1	X	11	1	X	13	2	2L	13	4	14	10	6	8	9	7	9	9	9	9	10	10	9	10	10							
	2nd	X	8	1	X	14	2	X	X	5	2L	12	8	2½L	2L	11	2L	2L	13	2L	2L	15	2L	2L	2L	2L	2L	2L							
	3rd	X	9	1	X	X	3	X	X	8	2½L	2L	12	3L	2L	15	2½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L							

TABLE: 9-11

### MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4½L	4L	4L	4L	3L	3L	3L	12	2½L	2½L	10	14	2½L	10	13	3L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	4½L	4½L	4L	4L	4L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	5½L	5L	4½L	4½L	4L	3½L	3L	2L	3L	12	2L	2½L	10	14	2L
+15	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3L	2L	3L	12	2L	2½L	10	14	2L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	4L	3½L	3½L	3½L	3L	3L	3L	3L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	4L	4½L	4½L	4L	3½L	3L	4L	4L	3½L	3L	4L	3½L	3½L	3½L
+10	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3½L	3½L	3L	3L	3L	2½L	11	15	2½L	10	13	2L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	3½L	4L	4L	3½L	3½L	3½L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	2½L	2½L	2½L	11	14	2L	10	13	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	4L	3L	3½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	4½L	4½L	3½L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	2½L	2½L	2½L	2L	11	13	15	10	12	14	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4L	3L	3L	4L	3½L	3L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	3½L	3L	4½L	4L	3L	4L	4L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	3L	2L	2½L	2½L	15	11	13	14	10	12	13	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4½L	4L	3L	4L	3½L	3L	3½L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L
-10	1st	X	X	12	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2L	13	11	12	12	9	11	12	9	11	12
	2nd	X	X	13	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	14	X	X	X	X	X	X	4L	3L	2L	4L	3½L	2½L	4L	3½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-15	1st	X	X	7	X	X	13	X	X	X	2½L	2L	15	2½L	2½L	2L	15	2L	11	10	11	11	9	11	11	9	11	12
	2nd	X	X	8	X	X	14	X	X	X	3L	2½L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	9	X	X	X	X	X	X	3½L	2½L	2L	3½L	3½L	14	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-20	1st	X	13	3	X	X	9	X	X	13	2½L	2L	12	2½L	2½L	2L	15	15	9	10	10	10	9	10	10	9	10	11
	2nd	X	15	4	X	X	10	X	X	X	3L	2L	2L	3L	2½L	2L	3L	2½L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L
	3rd	X	X	5	X	X	12	X	X	X	3½L	2½L	2L	3½L	3L	12	3½L	3L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L

VOLUME 140,000 (Veh./Day)

SPEED 50 (MPH)

%TRUCK 10%

%GRADE +/-

TABLE: 9-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	6L	6L	5½L	5L	5½L	5½L	4L	4½L	5L	3½L	4L	3½L	14	2½L	2½L	11	14	2½L
	2nd	X	X	X	X	X	X	X	X	X	6½L	6L	5½L	6L	6L	5½L	5L	5½L	5½L	4L	4½L	4½L	3½L	3½L	3½L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6½L	6L	6½L	6L	6L	6L	6L	6L	5L	5½L	5L	4L	4L	4L	3½L	4L	4L
+15	1st	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5L	5L	5L	4L	4½L	4½L	3½L	3½L	3½L	14	2½L	2½L	10	14	2L
	2nd	X	X	X	X	X	X	X	X	X	6½L	6L	5L	5½L	5½L	5½L	5L	5L	4L	4½L	4½L	3½L	3½L	3½L	2½L	3L	3L	
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	5½L	6½L	6L	5½L	5L	6L	5½L	5L	5L	5L	4L	4L	4L	3½L	3½L	4L
+10	1st	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4L	4½L	4½L	3L	3½L	3½L	14	2½L	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	5L	4L	4L	4½L	4L	3L	3L	3L	3½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	6L	5L	6L	6L	5½L	5½L	5½L	5L	5L	5L	5L	4L	4L	4L	3½L	3½L	4L
+5	1st	X	X	X	X	X	X	X	X	X	5½L	5L	4L	4½L	4½L	4½L	4L	4L	4L	3L	3½L	3½L	14	2½L	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	5L	4½L	5½L	5L	4½L	4½L	5L	4½L	4L	4L	4L	3L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6L	5½L	5L	5½L	5½L	5L	5L	5L	4½L	4L	4L	4L	3½L	3½L	3L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4½L	4L	3½L	4L	4L	3L	3½L	3L	14	2L	2L	10	13	15
	2nd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	5L	4½L	4½L	4½L	4½L	4L	4L	4L	3L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6L	5L	4L	6L	5½L	4½L	5L	5L	4½L	5L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L
	1st	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	3L	3½L	3½L	3½L	3L	3L	3L	3L	14	2L	2L	10	12	14
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	5L	4½L	4L	4½L	4L	4L	4L	4L	4L	3L	3L	3L	2½L	2½L	2½L
-5	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5½L	5L	4½L	5L	5L	4½L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L
	1st	X	X	X	X	X	X	X	X	X	4½L	3½L	3L	4L	4L	3½L	3½L	3½L	3L	3L	3L	3L	13	2L	15	10	12	14
	2nd	X	X	X	X	X	X	X	X	X	5L	4L	3L	4½L	4½L	3½L	4½L	4L	4L	3½L	4L	3L	3L	3L	3L	2½L	2½L	2½L
-10	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3L	5½L	5L	4L	5L	5L	4½L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L
	1st	X	X	12	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3L	3L	3L	3L	13	15	14	10	12	13
	2nd	X	X	13	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	
-15	3rd	X	X	14	X	X	X	X	X	X	5L	4L	3L	5L	4½L	3½L	5L	4½L	4L	4L	4L	4L	4L	4L	3½L	3½L	3½L	3½L
	1st	X	X	7	X	X	14	X	X	X	4L	3L	2L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L	2½L	13	15	13	10	11	12
	2nd	X	X	8	X	X	X	X	X	X	4½L	3L	2L	4½L	4L	3L	4L	4L	3½L	3½L	3½L	3L	3L	2½L	2½L	2½L	2½L	2½L
-20	3rd	X	X	9	X	X	X	X	X	X	5L	3½L	2½L	5L	4½L	3½L	5L	4½L	4L	4L	4L	4L	4L	3½L	3L	3½L	3½L	3½L

VOLUME: 220,000 (VEH./DAY)

SPEED: 50 (MPH)

%TRUCK: 10%

%GRADE: 7+

TABLE: 10-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	3	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	8	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	-	-																									
	2nd	3	-																									
	3rd	6	-																									

VOLUME: 3,800 (VEH./DAY)

SPEED: 50 (MPH)

%TRUCK: 20%

%GRADE: 0 to 3

TABLE: 10-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 5,600 (VEH/DAY) SPEED: 50 (M.P.H.) %TRUCK: 20% %GRADE: 0 to 3

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	9	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	1	-																									
	2nd	3	-																									
	3rd	7	-																									

TABLE: 10-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 8,400 (VEH/DAY) SPEED: 50 (M.P.H.) %TRUCK: 20% %GRADE: 0 to 3

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+15	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+10	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+5	1st	14	-	-	12	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
GROUND LEVEL	1st	11	-	-	10	-																						
	2nd	15	-	-	X	-																						
	3rd	X	-	-	X	-																						
-5	1st	8	-	-	8	-																						
	2nd	12	-	-	14	-																						
	3rd	15	-	-	X	-																						
-10	1st	5	-	-	6	-																						
	2nd	9	-	-	12	-																						
	3rd	13	-	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	-	-	15	-																						
-20	1st	1	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	13	-																						

TABLE: 10-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20		1st	X	X	-	X	-	-	15	-																		
		2nd	X	X	-	X	-	-	X	-																		
		3rd	X	X	-	X	-	-	X	-																		
+15		1st	X	X	-	X	-	-	14	-																		
		2nd	X	X	-	X	-	-	X	-																		
		3rd	X	X	-	X	-	-	X	-																		
+10		1st	X	X	-	14	-	-	12	-																		
		2nd	X	X	-	X	-	-	X	-																		
		3rd	X	X	-	X	-	-	X	-																		
+5		1st	14	X	-	12	-	-	11	-																		
		2nd	X	X	-	X	-	-	X	-																		
		3rd	X	X	-	X	-	-	X	-																		
GROUND LEVEL		1st	11	X	-	10	-	-	10	-																		
		2nd	15	X	-	X	-	-	X	-																		
		3rd	X	X	-	X	-	-	X	-																		
-5		1st	8	8	-	8	-	-	8	-																		
		2nd	12	9	-	14	-	-	15	-																		
		3rd	X	11	-	X	-	-	X	-																		
-10		1st	5	4	-	6	-	-	7	-																		
		2nd	9	5	-	12	-	-	14	-																		
		3rd	13	7	-	X	-	-	X	-																		
-15		1st	2	-	-	4	-	-	6	-																		
		2nd	6	-	-	10	-	-	12	-																		
		3rd	10	3	-	X	-	-	X	-																		
-20		1st	1	-	-	3	-	-	5	-																		
		2nd	3	-	-	8	-	-	11	-																		
		3rd	7	-	-	14	-	-	X	-																		

VOLUME: 13,000 (VEH./DAY)

SPEED: 50 (M.P.H.)

%TRUCK: 20%

%GRADE: 0 to

VOLUME: 13,000 (VEH./DAY) SPEED: 50 (M.P.H.) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 10-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	-	-	13	-																
	2nd	X	X	-	X	X	-	X	-	-	3L	-																
	3rd	X	X	-	X	X	-	X	-	-	3½L	-																
+15	1st	X	X	-	X	X	-	14	-	-	12	-																
	2nd	X	X	-	X	X	-	X	-	-	3L	-																
	3rd	X	X	-	X	X	-	X	-	-	3½L	-																
+10	1st	X	X	-	14	X	-	12	-	-	11	-																
	2nd	X	X	-	X	X	-	X	-	-	2½L	-																
	3rd	X	X	-	X	X	-	X	-	-	3L	-																
+5	1st	15	X	-	13	15	-	11	-	-	10	-																
	2nd	X	X	-	X	X	-	X	-	-	2L	-																
	3rd	X	X	-	X	X	-	X	-	-	2½L	-																
GROUND LEVEL	1st	12	12	-	11	12	-	10	-	-	9	-																
	2nd	15	13	-	X	15	-	X	-	-	2L	-																
	3rd	X	15	-	X	X	-	X	-	-	2½L	-																
-5	1st	9	8	-	9	8	-	9	-	-	9	-																
	2nd	13	9	-	14	11	-	15	-	-	2L	-																
	3rd	X	11	-	X	14	-	X	-	-	2L	-																
-10	1st	6	4	-	7	5	-	7	-	-	8	-																
	2nd	10	5	-	12	8	-	14	-	-	15	-																
	3rd	14	7	-	X	11	-	X	-	-	2L	-																
-15	1st	3	1	-	5	2	-	6	-	-	7	-																
	2nd	7	1	-	10	5	-	13	-	-	14	-																
	3rd	11	3	-	X	8	-	X	-	-	2L	-																
-20	1st	1	1	-	3	-	-	5	-	-	6	-																
	2nd	4	1	-	8	-	-	11	-	-	13	-																
	3rd	8	1	-	14	4	-	X	-	-	2L	-																

VOLUME: 19,000 (VEH./DAY)      SPEED: 50 (MPH)      %TRUCK: 20%      %GRADE: 0 to

VOLUME: 19,000 (VEH./DAY) SPEED: 50 (M.P.H.) %TRUCK: 20% %GRADE: 0 to 3



TABLE: 10-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	14	X	-	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	15	X	X	13	X	-	11	2L	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	13	15	X	11	14	-	10	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	15	12	12	12	12	12	10	12	-	10	12	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	13	X	X	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	14	X	X	X	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	12	8	8	10	9	8	9	9	-	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	15	12	10	X	12	-	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	9	X	15	12	X	X	-	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	9	4	3	8	4	3	8	7	-	8	8	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	13	5	3	12	8	6	13	11	-	15	13	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	7	5	X	11	8	X	15	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	7	1	-	6	2	-	6	4	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	10	1	-	11	5	2	13	8	-	5	11	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	14	1	-	X	8	4	X	12	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	4	1	-	4	X	X	5	-	-	6	4	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	8	1	-	9	2	X	12	5	-	14	9	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	12	1	-	15	5	X	X	10	-	2L	14	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME 28,000 (VEH/DAY) SPEED 50 (MPH) %TRUCK 20% %GRADE 0 to 3

TABLE: 10-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	15	X	X	13	2½L	3L	11	2½L	2½L	10	14	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	14	X	X	12	2½L	2½L	11	15	2½L	10	13	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3L	3½L	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	13	15	X	11	14	2L	10	12	15	10	12	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	X	12	13	11	12	13	10	12	13	10	12	13	9	11	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	-	-	-	-	-	-	-	-	-	-
-5	1st	15	8	8	14	9	9	10	10	9	9	10	11	9	10	11	9	10	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	X	12	10	X	14	12	2L	15	13	2L	2L	2L	2L	2L	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	-	-	-	-	-	-	-	-	-	-
-10	1st	12	4	3	12	6	5	9	7	6	8	8	7	8	9	8	9	9	-	-	-	-	-	-	-	-	-	-
	2nd	X	6	4	X	9	6	15	11	10	2L	13	11	2L	15	12	2L	2L	-	-	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	12	8	X	X	11	2L	2L	15	2½L	2L	2L	2½L	2½L	-	-	-	-	-	-	-	-	-	-
-15	1st	10	1	1	10	2	1	7	4	3	8	6	4	8	7	6	8	8	-	-	-	-	-	-	-	-	-	-
	2nd	14	3	1	15	5	2	14	9	5	15	11	8	2L	14	11	2L	15	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	1	X	8	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	-	-	-	-	-	-	-	-	-	-
-20	1st	7	1	1	8	1	1	6	2	-	7	4	1	7	6	4	8	7	-	-	-	-	-	-	-	-	-	-
	2nd	11	1	1	14	1	1	13	6	2	14	9	5	15	12	9	2L	2L	-	-	-	-	-	-	-	-	-	-
	3rd	15	1	1	X	5	1	X	10	4	2L	15	9	2L	2L	14	2½L	2L	-	-	-	-	-	-	-	-	-	-

VOLUME 43,000 (VEH/DAY) SPEED 50 (MPH) %TRUCK 20% %GRADE 0 to 3

TABLE: 1C-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3L	3L	3½L	13	2½L	3L	11	2½L	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	3L	3½L	3½L	3L	2½L	3L	-					
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3L	3½L	-						
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	12	2½L	2½L	11	15	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-						
+10	1st	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	11	15	2½L	10	14	2L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	-						
+5	1st	X	X	X	X	X	X	X	X	X	15	15	2L	11	14	2L	10	13	15	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-						
GROUND LEVEL	1st	X	X	13	X	X	13	X	14	14	14	13	14	10	12	14	10	12	13	9	11	-						
	2nd	X	X	14	X	X	15	X	X	X	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	14	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-						
-5	1st	X	12	8	X	X	9	X	12	10	13	11	11	10	11	11	2L	11	11	2L	11	-						
	2nd	X	14	8	X	X	11	X	X	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	X	10	X	X	13	X	X	X	2½L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	-						
-10	1st	X	8	4	X	10	5	15	9	7	12	9	8	9	9	9	9	10	10	2L	10	-						
	2nd	X	10	4	X	13	7	X	13	10	2L	14	12	2L	2L	15	2L	2L	2L	2L	2L	-						
	3rd	X	12	5	X	X	9	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	3L	-						
-15	1st	15	4	1	X	6	1	14	6	3	11	7	5	9	8	7	8	8	8	8	9	-						
	2nd	X	6	1	X	9	3	X	10	6	2L	12	9	2L	14	12	2L	2L	14	2L	2L	-						
	3rd	X	8	1	X	12	5	X	15	9	2L	2L	13	2L	2L	2L	2½L	2½L	2L	3L	2½L	-						
-20	1st	13	1	1	14	3	1	13	4	1	10	4	2	8	6	4	2L	7	6	2L	8	-						
	2nd	X	2	1	X	6	1	X	8	2	2L	10	6	2L	13	9	2L	2L	12	2L	2L	-						
	3rd	X	3	1	X	9	1	X	12	15	2L	2L	10	2L	2L	14	2½L	2L	2L	2½L	2½L	-						

VOLUME: 64,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 1C-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3L	3L	12	2½L	3L	11	15	2½L	10	13	2½L	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	-	
	3rd	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	3½L	-
+15	1st	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3½L	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2L	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3L	3L	2½L	3L	3L	2½L	3L	2½L	3L	2½L	2½L	2½L	-	
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-
+10	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	15	2½L	2½L	11	15	2½L	10	12	2L	9	12	15	9	12	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-
+5	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2L	14	15	2L	11	14	2L	10	13	16	9	12	14	9	11	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	3L	3L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	15	2½L	2L	15	14	14	14	10	12	14	10	12	14	9	11	13	9	11	-
	2nd	X	X	14	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	15	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-
-5	1st	X	X	9	X	X	10	X	X	11	2½L	2L	12	13	12	12	10	11	12	9	11	12	9	11	12	9	11	-
	2nd	X	X	10	X	X	12	X	X	14	3L	2L	15	2½L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-
	3rd	X	X	11	X	X	14	X	X	X	3½L	2½L	2L	3L	2L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-
-10	1st	X	12	14	X	15	6	X	X	8	2L	14	9	13	11	10	10	10	9	10	11	9	10	11	9	10	10	-
	2nd	X	14	5	X	X	8	X	X	10	2½L	2L	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-
	3rd	X	15	6	X	X	10	X	X	13	3L	2L	2L	3L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	-
-15	1st	X	8	1	X	11	2	X	13	4	2L	12	6	12	9	7	9	9	9	9	10	10	9	10	10	9	10	-
	2nd	X	10	1	X	14	4	X	X	7	2L	2L	10	2L	2L	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-
	3rd	X	11	1	X	5	X	X	10	2L	2L	13	3L	2L	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	-
-20	1st	X	4	1	X	8	1	X	10	1	15	10	3	12	8	5	8	8	7	9	9	8	9	9	9	9	10	-
	2nd	X	6	1	X	11	1	X	15	3	2L	15	7	2L	14	10	2L	15	13	2L	15	2L	2L	3L	2L	2L	-	
	3rd	X	7	1	X	14	1	X	X	6	2½L	2L	11	2½L	2L	15	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	-

TABLE 10-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]

VOLUME	140,000 (VEH./DAY)	SPEED	50 (MPH)	%TRUCK	20	%GRADE	0 to 3
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TABLE: 10-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	4½L	5L	5L	4L	4L	4L	3L	3L	3L	12	2L	2½L	10	14	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	6L	5L	5½L	5½L	5L	4½L	5L	5L	4L	4L	4L	3L	3L	3½L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	6L	5½L	6L	6L	5½L	5½L	5½L	4½L	5L	4½L	3½L	4L	4L	3½L	3½L	4L	
+15	1st	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	4½L	4½L	4½L	3½L	4L	4L	3L	3L	3L	12	15	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5L	5L	5L	4½L	4½L	4½L	3½L	4L	3L	3L	3L	3L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	5½L	5L	6L	5½L	5½L	5½L	5L	4½L	4½L	4½L	3½L	4L	4L	3½L	3½L	4L	
+10	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	3½L	4L	3½L	3L	3L	2½L	11	15	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4½L	4½L	4½L	3½L	4L	3½L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	5L	5L	4½L	4½L	4L	3½L	3½L	4L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4L	4L	4L	3½L	3½L	3½L	2½L	3L	2½L	11	14	2L	10	13	15
	2nd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	4½L	4L	4L	5L	4L	3½L	3½L	3L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4L	5½L	5L	4½L	4L	4L	4½L	4½L	4L	3½L	3L	3½L	3L	3L	3½L	3L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3L	3L	2½L	2½L	11	14	15	10	12	14
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	3L	2½L	2½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5½L	5L	4L	5L	5L	4½L	4½L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3L	3L	3½L	3L	2½L	2½L	2L	11	13	15	10	12	14
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3½L	4L	4L	3½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	5L	4½L	4L	5L	4½L	4L	4L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
-10	1st	X	X	15	X	X	X	X	X	X	4L	3L	2½L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	11	13	14	10	12	13	
	2nd	X	X	15	X	X	X	X	X	X	5½L	3½L	2½L	4½L	4L	3L	4L	3½L	3L	3½L	3½L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3L	5L	4½L	3½L	4½L	4½L	4L	4L	3L	2½L	2½L	2½L	2½L	2½L	2½L	
-15	1st	X	X	9	X	X	15	X	X	X	3½L	3L	2L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L	15	10	12	13	9	11	12
	2nd	X	X	10	X	X	X	X	X	X	4L	3L	2L	4L	3½L	3L	3½L	3½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	
	3rd	X	X	11	X	X	X	X	X	X	4½L	3½L	2½L	4L	4L	3L	3½L	4L	3½L	4L	4L	3L	2½L	2½L	2½L	2½L	2½L	
-20	1st	X	X	5	X	X	11	X	X	X	3½L	2½L	2L	3L	3L	2L	3L	2L	2½L	2½L	2½L	14	10	12	12	9	11	12
	2nd	X	X	6	X	X	13	X	X	X	4L	3L	2L	4	3½L	2½L	3½L	3½L	2½L	3L	3L	2L	2½L	2½L	2L	2½L	2½L	
	3rd	X	X	7	X	X	15	X	X	X	4L	2L	2L	4½L	4L	3L	4½L	4L	3L	4L	3L	2L	2½L	2½L	2L	2½L	2½L	

VOLUME	220,000 (VEH/DAY)	SPEED	50 (MPH)	%TRUCK	20	%GRADE	0.0
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MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]

TABLE: 11-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 5,600 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+15	1st	X	-	-	X	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+10	1st	X	-	-	14	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
+5	1st	14	-	-	12	-																						
	2nd	X	-	-	X	-																						
	3rd	X	-	-	X	-																						
GROUND LEVEL	1st	11	-	-	10	-																						
	2nd	14	-	-	15	-																						
	3rd	X	-	-	X	-																						
-5	1st	8	-	-	6	-																						
	2nd	12	-	-	14	-																						
	3rd	15	-	-	X	-																						
-10	1st	5	-	-	6	-																						
	2nd	9	-	-	12	-																						
	3rd	12	-	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	-	-	15	-																						
-20	1st	1	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	13	-																						

TABLE: 11-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 6,400 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+15	1st	X	X	-	X	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+10	1st	X	X	-	14	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
+5	1st	14	X	-	12	-																						
	2nd	X	X	-	X	-																						
	3rd	X	X	-	X	-																						
GROUND LEVEL	1st	11	12	-	10	-																						
	2nd	15	13	-	X	-																						
	3rd	X	15	-	X	-																						
-5	1st	8	8	-	8	-																						
	2nd	12	9	-	14	-																						
	3rd	X	11	-	X	-																						
-10	1st	5	3	-	6	-																						
	2nd	9	5	-	12	-																						
	3rd	13	7	-	X	-																						
-15	1st	2	-	-	4	-																						
	2nd	6	-	-	10	-																						
	3rd	10	3	-	15	-																						
-20	1st	1	-	-	2	-																						
	2nd	3	-	-	8	-																						
	3rd	7	-	-	14	-																						

TABLE: 11-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	X	X	-	X	-																			
+15	1st	X	X	-	X	X	-	14	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	X	X	-	X	-																			
+10	1st	X	X	-	14	X	-	12	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	X	X	-	X	-																			
+5	1st	15	X	-	12	15	-	11	-																			
	2nd	X	X	-	X	X	-	X	-																			
	3rd	X	X	-	X	X	-	X	-																			
GROUND LEVEL	1st	12	12	-	10	12	12	10	-																			
	2nd	15	13	-	X	15	-	X	-																			
	3rd	X	15	-	X	X	-	X	-																			
-5	1st	9	8	-	8	8	-	8	-																			
	2nd	13	9	-	14	11	-	15	-																			
	3rd	X	11	-	X	14	-	X	-																			
-10	1st	6	4	-	7	5	-	7	-																			
	2nd	10	5	-	12	8	-	14	-																			
	3rd	14	7	-	X	11	-	X	-																			
-15	1st	3	1	-	5	7	-	6	-																			
	2nd	7	1	-	10	5	-	13	-																			
	3rd	11	3	-	X	8	-	X	-																			
-20	1st	1	1	-	3	-	-	5	-																			
	2nd	4	1	-	8	-	-	11	-																			
	3rd	8	1	-	14	4	-	X	-																			

VOLUME: 13,000 (VEH./DAY)

SPEED: 50 (M.P.H.)

%TRUCK: 20%

%GRADE: 4 to 0

VOLUME: 13,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 11-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	-	15	X	-	13	-																
	2nd	X	X	X	X	X	-	X	X	-	X	-																
	3rd	X	X	X	X	X	-	X	X	-	X	-																
+15	1st	X	X	X	X	X	-	14	X	-	12	-																
	2nd	X	X	X	X	X	-	X	X	-	X	-																
	3rd	X	X	X	X	X	-	X	X	-	X	-																
+10	1st	X	X	X	15	X	-	13	X	-	11	-																
	2nd	X	X	X	X	X	-	X	X	-	2½L	-																
	3rd	X	X	X	X	X	-	X	X	-	3L	-																
+5	1st	X	X	X	13	15	-	11	14	-	10	-																
	2nd	X	X	X	X	X	-	X	X	-	2L	-																
	3rd	X	X	X	X	X	-	X	X	-	2½L	-																
GROUND LEVEL	1st	15	12	12	11	12	-	10	12	-	10	-																
	2nd	X	14	13	X	15	-	X	X	-	2L	-																
	3rd	X	15	14	X	X	-	X	X	-	2½L	-																
-5	1st	12	8	8	9	9	-	9	9	-	9	-																
	2nd	X	10	8	14	12	-	15	13	-	2L	-																
	3rd	X	11	9	X	14	-	X	X	-	2L	-																
-10	1st	9	4	3	7	5	-	7	6	-	8	-																
	2nd	13	5	4	13	8	-	14	11	-	15	-																
	3rd	X	7	5	X	11	-	X	15	-	2L	-																
-15	1st	7	1	-	5	2	-	6	4	-	7	-																
	2nd	10	1	-	11	5	-	13	8	-	14	-																
	3rd	14	3	-	X	8	-	X	12	-	2L	-																
-20	1st	4	1	-	3	1	-	5	-	-	6	-																
	2nd	8	1	-	9	1	-	12	5	-	14	-																
	3rd	12	1	-	14	4	-	X	10	-	2L	-																

VOLUME: 19,000 (VEH./DAY)

SPEED: 50 (M.P.H.)

%TRUCK: 20%

%GRADE: 4 to 0

VOLUME: 19,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE 11-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 28,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	13	3L	3L	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3½L	3½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	15	X	X	12	2½L	3L	11	2½L	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	X	X	X	12	15	2½L	11	15	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	12	15	X	11	14	2L	10	12	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	14	12	12	11	12	13	10	12	13	9	11	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-5	1st	15	8	8	12	9	9	9	12	9	9	10	10	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	12	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-10	1st	12	4	3	10	6	4	8	7	6	8	8	7	8	9	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	6	4	15	8	6	15	11	10	2L	13	11	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	11	8	X	15	11	2L	2L	15	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-15	1st	10	1	1	8	2	-	7	4	2	7	6	4	8	7	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	14	2	1	14	5	2	13	8	5	15	11	8	2L	13	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	1	X	8	3	X	13	8	2L	2L	12	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-20	1st	7	1	1	6	1	-	5	2	-	6	4	2L	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	11	1	1	12	2	-	12	6	2	14	9	5	15	12	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	15	1	1	X	5	-	X	10	4	2L	15	9	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-

TABLE 11-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 43,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 4 to 6

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	15	3L	3½L	12	2½L	3L	11	2L	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	3L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	-							
+15	1st	X	X	X	X	X	X	X	X	X	14	2½L	3L	12	2½L	2½L	11	15	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-							
+10	1st	X	X	X	X	X	X	X	X	X	13	15	2½L	11	15	2½L	11	14	2L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	3L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3L	-							
+5	1st	X	X	X	X	X	X	X	X	X	12	15	2L	11	14	2L	10	12	15	9	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3½L	3½L	3L	-							
GROUND LEVEL	1st	X	14	12	X	14	13	X	13	13	11	13	13	10	12	13	10	12	13	9	-							
	2nd	X	X	13	X	15	X	X	X	X	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2L	-							
	3rd	X	X	14	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	-							
-5	1st	X	10	8	X	10	9	15	10	10	10	11	11	9	11	11	9	11	11	9	-							
	2nd	X	12	8	X	13	11	X	15	13	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	-							
	3rd	X	13	10	X	X	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	-							
-10	1st	X	6	3	X	7	5	13	8	6	10	9	8	9	9	9	9	10	10	9	-							
	2nd	X	8	4	X	10	7	X	12	10	2L	14	11	2L	15	14	2L	2L	2L	2L	-							
	3rd	X	9	5	X	13	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	-							
-15	1st	13	2	1	14	4	1	12	10	3	9	7	5	8	8	6	8	8	8	8	-							
	2nd	X	3	1	X	7	3	X	9	6	2L	12	9	2L	14	11	2L	2L	2L	2L	-							
	3rd	X	5	1	X	10	4	X	14	8	2L	2L	12	2L	2L	2L	2½L	2½L	2L	3L	-							
-20	1st	10	1	1	12	1	1	12	3	1	8	5	2	8	6	4	8	7	6	8	-							
	2nd	14	1	1	X	3	1	X	7	2	15	10	6	2L	13	9	2L	14	12	2L	-							
	3rd	X	1	1	X	6	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	-							







MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

[illegible]



TABLE: 12-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 5,600 (VEH/DAY) SPEED: 50 (M.P.H.) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st.	X	-	-	X	-																							
	2nd.	X	-	-	X	-																							
	3rd.	X	-	-	X	-																							
+15	1st.	X	-	-	X	-																							
	2nd.	X	-	-	X	-																							
	3rd.	X	-	-	X	-																							
+10	1st.	X	-	-	14	-																							
	2nd.	X	-	-	X	-																							
	3rd.	X	-	-	X	-																							
+5	1st.	14	-	-	12	-																							
	2nd.	X	-	-	X	-																							
	3rd.	X	-	-	X	-																							
GROUND LEVEL	1st.	11	-	-	10	-																							
	2nd.	15	-	-	X	-																							
	3rd.	X	-	-	X	-																							
-5	1st.	8	-	-	8	-																							
	2nd.	12	-	-	14	-																							
	3rd.	15	-	-	X	-																							
-10	1st.	5	-	-	6	-																							
	2nd.	9	-	-	12	-																							
	3rd.	13	-	-	X	-																							
-15	1st.	2	-	-	4	-																							
	2nd.	6	-	-	10	-																							
	3rd.	10	-	-	13	-																							
-20	1st.	1	-	-	2	-																							
	2nd.	3	-	-	8	-																							
	3rd.	7	-	-	-	-																							

TABLE: 12-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 8,400 (VEH/DAY) SPEED: 50 (M.P.H.) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.	
+20	1st.	X	-	-	X	-	-	15	-																				
	2nd.	X	-	-	X	-	-	X	-																				
	3rd.	X	-	-	X	-	-	X	-																				
+15	1st.	X	-	-	X	-	-	14	-																				
	2nd.	X	-	-	X	-	-	X	-																				
	3rd.	X	-	-	X	-	-	X	-																				
+10	1st.	X	X	-	14	-	-	12	-																				
	2nd.	X	X	-	X	-	-	X	-																				
	3rd.	X	X	-	X	-	-	X	-																				
+5	1st.	14	X	-	12	-	-	11	-																				
	2nd.	X	X	-	X	-	-	X	-																				
	3rd.	X	X	-	X	-	-	X	-																				
GROUND LEVEL	1st.	11	X	-	10	-	-	10	-																				
	2nd.	15	13	-	X	-	-	X	-																				
	3rd.	X	15	-	X	-	-	X	-																				
-5	1st.	8	8	-	8	-	-	8	-																				
	2nd.	12	9	-	14	-	-	15	-																				
	3rd.	X	11	-	X	-	-	X	-																				
-10	1st.	5	1	-	6	-	-	7	-																				
	2nd.	9	5	-	12	-	-	14	-																				
	3rd.	13	7	-	X	-	-	X	-																				
-15	1st.	2	-	-	4	-	-	6	-																				
	2nd.	6	-	-	10	-	-	12	-																				
	3rd.	10	3	-	X	-	-	X	-																				
-20	1st.	1	-	-	3	-	-	5	-																				
	2nd.	3	-	-	8	-	-	11	-																				
	3rd.	7	-	-	14	-	-	X	-																				

TABLE: 12-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 13,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT.)		RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
			110			170			250			380			570			850			1300			1900			2900		
			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd		
+20	1st	X	X	-	X	X	-	15	-	-	13	-																	
	2nd	X	X	-	X	X	-	X	-	-	3L	-																	
	3rd	X	X	-	X	X	-	X	-	-	3½L	-																	
+15	1st	X	X	-	X	X	-	14	-	-	12	-																	
	2nd	X	X	-	X	X	-	X	-	-	3L	-																	
	3rd	X	X	-	X	X	-	X	-	-	3½L	-																	
+10	1st	X	X	-	14	X	-	12	-	-	11	-																	
	2nd	X	X	-	X	X	-	X	-	-	2½L	-																	
	3rd	X	X	-	X	X	-	X	-	-	3½L	-																	
+5	1st	X	X	-	13	15	-	11	-	-	10	-																	
	2nd	X	X	-	X	X	-	X	-	-	2L	-																	
	3rd	X	X	-	X	X	-	X	-	-	2½L	-																	
GROUND LEVEL	1st	14	X	-	11	15	-	10	-	-	9	-																	
	2nd	X	14	-	X	15	-	X	-	-	2L	-																	
	3rd	X	15	-	X	X	-	X	-	-	2½L	-																	
-5	1st	11	8	-	9	8	-	9	-	-	9	-																	
	2nd	14	9	-	14	11	-	15	-	-	2L	-																	
	3rd	X	11	-	X	14	-	X	-	-	2L	-																	
-10	1st	8	4	-	7	5	-	7	-	-	8	-																	
	2nd	12	5	-	12	8	-	14	-	-	15	-																	
	3rd	15	7	-	X	11	-	X	-	-	2L	-																	
-15	1st	5	1	-	5	2	-	6	-	-	7	-																	
	2nd	9	1	-	10	5	-	13	-	-	14	-																	
	3rd	13	3	-	X	8	-	X	-	-	2L	-																	
-20	1st	2	1	-	3	-	-	5	-	-	12	-																	
	2nd	6	1	-	8	-	-	11	-	-	13	-																	
	3rd	10	1	-	14	4	-	X	-	-	2L	-																	

TABLE: 12-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME 19,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	11	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+15	1st	X	X	X	X	X	X	14	X	-	12	2½L	-	11	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+10	1st	X	X	X	15	X	X	13	X	-	11	15	-	11	15	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	3L	-												
+5	1st	X	X	X	13	15	X	12	15	-	11	14	-	10	13	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	3L	-												
GROUND LEVEL	1st	X	12	12	12	15	12	10	12	-	10	12	-	9	11	-												
	2nd	X	14	13	X	15	14	X	X	-	2L	2L	-	2L	2L	-												
	3rd	X	15	14	X	X	X	X	X	-	2½L	2L	-	2½L	2½L	-												
-5	1st	14	8	8	10	9	8	9	9	-	9	10	-	9	10	-												
	2nd	X	10	8	15	12	10	X	14	-	2L	15	-	2L	2L	-												
	3rd	X	11	9	X	15	12	X	X	-	2L	2L	-	2½L	2½L	-												
-10	1st	11	4	3	8	5	4	8	7	-	8	8	-	8	8	-												
	2nd	15	6	4	13	8	6	14	11	-	15	13	-	15	13	-												
	3rd	X	7	5	X	11	8	X	15	-	2L	2L	-	2L	2L	-												
-15	1st	8	1	-	6	2	-	6	4	-	7	6	-	8	7	-												
	2nd	12	2	-	11	5	2	13	8	-	15	11	-	2L	13	-												
	3rd	X	3	-	X	8	4	X	12	-	2L	2L	-	2L	2L	-												
-20	1st	5	1	-	4	1	-	5	1	-	6	4	2L	7	5	-												
	2nd	9	1	-	9	2	-	12	6	-	14	9	-	15	12	-												
	3rd	13	1	-	15	5	-	X	10	-	2L	15	-	2L	2L	-												

TABLE: 12-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	-									
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	-									
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	4L	4L	3½L	3½L	-									
+15	1st	X	X	X	X	X	X	13	X	X	13	2½L	3L	11	2½L	2½L	10	10	-									
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	-									
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-									
+10	1st	X	X	X	X	X	X	X	X	X	12	15	2½L	11	15	2L	10	13	-									
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-									
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3L	3½L	-									
+5	1st	X	X	X	X	X	X	13	15	X	11	14	2L	10	13	15	10	12	-									
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-									
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	-									
GROUND LEVEL	1st	X	13	12	X	12	13	11	15	12	10	13	13	10	12	13	9	11	-									
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	-									
	3rd	X	X	X	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	-									
-5	1st	X	9	8	14	9	9	10	10	9	9	10	10	9	10	11	9	10	-									
	2nd	X	10	8	X	12	10	X	14	12	2L	2L	2L	2L	2L	2L	2L	2L	-									
	3rd	X	12	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	-									
-10	1st	15	5	3	12	6	5	9	7	6	8	8	7	8	9	8	9	9	-									
	2nd	X	6	4	X	9	6	15	11	10	2L	13	11	2L	15	13	2L	2L	-									
	3rd	X	8	5	X	12	8	X	X	11	2L	2L	15	2½L	2L	2L	2½L	2½L	-									
-15	1st	11	1	1	10	2	1	7	4	3	8	6	4	8	7	6	8	8	-									
	2nd	15	2	1	15	5	2	14	9	5	15	11	8	2L	14	11	2L	15	-									
	3rd	X	4	1	X	8	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	-									
-20	1st	8	1	1	8	1	1	6	2	-	7	4	1	7	6	4	8	7	-									
	2nd	13	1	1	14	2	1	13	5	2	14	9	5	15	12	9	2L	14	-									
	3rd	X	1	1	X	5	1	X	10	4	2L	15	9	2L	2L	14	2½L	2L	-									

VOLUME: 28,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 7+

TABLE: 12-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3L	3L	3½L	13	2½L	3L	11	2½L	2½L	10	14	2½L	10	13	-			
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	3½L	4L	3½L	3½L	-			
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	12	2½L	2½L	11	15	2½L	10	14	2½L	6	13	-			
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+10	1st	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	11	15	2½L	10	14	2L	10	13	2L	9	12	-			
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+5	1st	X	X	X	X	X	X	X	X	X	15	15	2L	11	14	2L	10	13	15	10	12	14	9	12	-			
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3½L	-			
GROUND LEVEL	1st	X	X	13	X	X	13	X	14	14	14	15	14	10	12	14	10	12	13	9	11	13	9	11	-			
	2nd	X	X	14	X	X	14	X	X	X	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-			
	3rd	X	X	14	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-			
-5	1st	X	12	8	X	13	9	X	12	10	13	11	11	10	11	11	9	11	12	9	11	12	9	11	-			
	2nd	X	14	8	X	X	11	X	X	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-			
	3rd	X	X	10	X	X	13	X	X	X	2½L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-			
-10	1st	X	8	4	X	10	5	15	9	7	12	9	8	9	9	9	10	10	9	10	10	9	10	-				
	2nd	X	10	4	X	13	7	X	13	10	2L	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-			
	3rd	X	12	5	X	X	9	X	X	12	2½L	2L	15	2½L	2L	2½L	2½L	2½L	2½L	3L	3L	2½L	3L	3L	-			
-15	1st	15	4	1	X	6	1	14	6	3	11	7	5	9	8	7	9	9	8	9	9	9	9	10	-			
	2nd	X	6	1	X	9	1	X	10	6	2L	12	9	2L	14	12	2L	2L	14	2L	2L	2L	2L	2L	-			
	3rd	X	8	1	X	12	5	X	15	9	2L	2L	13	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	-			
-20	1st	13	1	1	14	3	1	13	4	1	10	5	2	8	6	4	2L	8	7	8	8	8	8	9	-			
	2nd	X	2	1	X	6	1	X	8	2	2L	10	6	2L	13	9	2L	15	13	2L	2L	2L	2L	2L	-			
	3rd	X	3	1	X	9	1	X	12	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2½L	15	3L	3L	-			



TABLE: 12-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																													
		110			170			250			380			570			850			1300			1900			2900					
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd			
+20	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3L	3L	122½L	3L	11	15	2½L	10	13	2L	9	12	-				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	5L	5L	4L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	-			
+15	1st	X	X	X	X	X	X	X	X	X	3½L	3L	3L	2½L	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2L	9	12	-			
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+10	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	15	2½L	2½L	11	15	2½L	10	13	2L	9	12	15	9	12	-			
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+5	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2L	14	15	2L	11	14	2L	10	13	15	9	12	14	9	11	-			
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	3½L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	15	2½L	2L	15	14	14	14	10	12	14	10	12	14	9	11	13	9	11	-			
	2nd	X	X	14	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-			
	3rd	X	X	15	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-			
-5	1st	X	X	9	X	X	10	X	X	11	2½L	2L	12	13	12	12	10	11	12	9	11	12	9	11	12	9	11	-			
	2nd	X	X	10	X	X	12	X	X	14	3L	2L	15	2½L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-			
	3rd	X	X	11	X	X	14	X	X	X	3½L	2½L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-			
-10	1st	X	12	4	X	15	6	X	X	8	2L	15	9	13	11	10	10	10	9	9	10	11	9	10	11	9	10	-			
	2nd	X	14	5	X	X	8	X	X	10	2½L	2L	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-			
	3rd	X	15	6	X	X	10	X	X	12	3L	2L	2L	3L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	-			
-15	1st	X	8	1	X	11	2	X	13	4	2L	12	6	12	9	7	9	9	9	9	10	10	9	10	10	9	10	-			
	2nd	X	10	1	X	14	4	X	X	7	2L	2L	10	2L	2L	12	2L	2L	14	2L	2L	15	2L	2L	2L	2L	2L	-			
	3rd	X	11	1	X	X	5	X	X	10	2½L	2L	13	3L	2L	2L	2L	2½L	2½L	3L	2½L	2½L	3L	3L	3L	3L	3L	-			
-20	1st	X	4	1	X	8	1	X	10	1	15	10	3	12	8	5	8	8	7	9	9	8	9	9	9	9	10	-			
	2nd	X	6	1	X	11	1	X	15	3	2L	15	7	2L	14	10	2L	15	13	2L	2L	2L	2L	2L	2L	2L	2L	-			
	3rd	X	7	1	X	14	1	X	X	6	2½L	2L	11	2½L	2L	15	2½L	2L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-			

VOLUME: 64,000 (VEH./DAY)

SPEED: 50 (MPH)

% TRUCK: 20%

% GRADE: 7+

VOLUME: 64,000 (VEH/DAY) SPEED: 50 (MPH) %TRUCK: 20% %GRADE: 7+

TABLE: 12-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																														VOLUME: 96,000 (Veh./Day)	SPEED: 50 (MPH)	%TRUCK: 20%	%GRADE: 7+
		110			170			250			380			570			850			1300			1900			2900									
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW									
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd				
+20	1st	X	X	X	X	X	X	X	X	X	5L	4½	4½	4L	4L	4L	3L	3L	3L	12	2½	2½	10	14	2½	10	13	2L							
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½	4½	4½	4L	4L	4L	3½	3L	3L	3L	2½	3L	3L	2½	2½	2½							
	3rd	X	X	X	X	X	X	X	X	X	5½L	6L	5L	5½	5L	4½	4½	4½	4L	3½	4L	4L	3½	3½	4L	3½	3½	4L	3½	3½	4L				
+15	1st	X	X	X	X	X	X	X	X	X	4½	4½	4L	4L	4L	3½	3L	3L	3L	12	2L	2½	10	14	2L	10	13	2L							
	2nd	X	X	X	X	X	X	X	X	X	5L	4½	4L	4½	4½	4L	3½	3½	3½	3L	3L	3L	2½	3L	3L	2½	2½	3L							
	3rd	X	X	X	X	X	X	X	X	X	5½	5L	4½	5L	5L	4L	4½	4½	4L	3½	3½	4L	3½	3½	4L	3½	3½	3½							
+10	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½	3½	3½	3L	3L	3L	2½	11	15	2½	10	13	2L	10	12	15							
	2nd	X	X	X	X	X	X	X	X	X	4½	4½	3½	4L	4L	3½	3½	3½	3L	2½	2½	3L	2½	2½	3L	2½	2½	3L							
	3rd	X	X	X	X	X	X	X	X	X	5L	4½	4L	5L	4½	4L	4½	4L	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½			
+5	1st	X	X	X	X	X	X	X	X	X	4L	3½	3L	3½	3½	3L	2½	2½	2½	11	14	2L	10	13	15	9	12	14							
	2nd	X	X	X	X	X	X	X	X	X	4½	4L	3L	4L	4L	3L	3½	3½	3L	2½	2½	3L	2½	2½	2½	2½	2½	2½							
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½	4½	4½	3½	4½	4L	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½			
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½	3L	2½	3L	3L	2½	2½	2½	2L	11	13	15	10	12	14	9	12	14							
	2nd	X	X	X	X	X	X	X	X	X	4L	3½	3L	4L	3½	3L	3½	3L	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½							
	3rd	X	X	X	X	X	X	X	X	X	4½	4L	3L	4½	4L	3L	4L	4L	3L	3½	3½	3L	3½	3½	3L	3½	3½	3½	3½	3½	3½	3½	3½		
-5	1st	X	X	X	X	X	X	X	X	X	3½	3L	2L	3L	3L	2L	2½	2½	15	11	13	14	10	12	13	9	11	13							
	2nd	X	X	X	X	X	X	X	X	X	4L	3L	2½	3½	2½	2½	3L	2L	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½							
	3rd	X	X	X	X	X	X	X	X	X	4L	3½	2½	4½	4L	3L	4L	3½	3L	3½	3L	3L	3L	3L	3½	3½	3L	3½	3½	3½	3½	3½			
-10	1st	X	X	X	X	X	14	X	X	X	3L	3½	2L	3L	2½	2L	2½	2L	13	11	12	12	9	11	12	9	11	12							
	2nd	X	X	X	X	X	X	X	X	X	3½	3L	2L	3½	3L	2L	3L	2½	2L	2½	2½	2½	2½	2½	2½	2½	2½	2½							
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2L	4L	3½	2½	4L	3½	2L	2½	2L	3L	3L	3L	3L	3L	3L	3L							
-15	1st	X	X	X	X	X	10	X	X	13	2½	2L	15	2½	2½	14	15	2L	11	10	11	11	9	11	11	9	11	12							
	2nd	X	X	X	X	X	12	X	X	X	3L	2½	2L	3½	3L	2½	3L	2½	2L	2½	2L	2L	2½	2½	2½	2½	2½	2½							
	3rd	X	X	X	X	X	14	X	X	X	3½	2½	2L	4L	3½	2L	4L	3½	2L	3½	3L	2½	3L	3L	3L	3L	3L	3L							
-20	1st	X	X	X	X	X	9	X	X	10	2½	2L	12	2½	2L	12	15	15	9	10	10	10	9	10	10	9	10	11							
	2nd	X	X	X	X	X	8	X	X	13	3L	2L	12	3L	2L	12	3L	2½	15	2L	2L	2L	2L	2L	2L	2L	2L								
	3rd	X	X	X	X	X	9	X	X	15	3½	2½	2L	3L	3L	2L	3½	3L	2L	3L	3L	2½	3L	3L	3L	3L	3L	3L							





TABLE: 13-1

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	8	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	X	-																									
	2nd	3	-																									
	3rd	6	-																									

VOLUME 2,500  
(VEH./DAY)

SPEED: 60  
M.P.H.

%TRUCK: 10%

%GRADE: 0 to 3

VOLUME: 2,500 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 13-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	11	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	9	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	1	-																									
	2nd	3	-																									
	3rd	7	-																									

VOLUME: 3,800

(VEH./DAY)

SPEED: 60 M.P.H.

%TRUCK: 10%

%GRADE: 0 to 3

VOLUME: 3,800 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 13-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+15	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+10	1st	X	-	-	14	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+5	1st	14	-	-	12	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
GROUND LEVEL	1st	11	-	-	10	-	-																					
	2nd	15	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
-5	1st	8	-	-	8	-	-																					
	2nd	12	-	-	14	-	-																					
	3rd	15	-	-	X	-	-																					
-10	1st	5	-	-	6	-	-																					
	2nd	9	-	-	12	-	-																					
	3rd	13	-	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	10	-	-																					
	3rd	10	-	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	7	-	-	13	-	-																					

VOLUME: 5,600 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 13-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-	-	15	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+15	1st	X	X	-	X	-	-	14	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+10	1st	X	X	-	14	-	-	12	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+5	1st	14	X	-	12	-	-	11	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
GROUND LEVEL	1st	11	12	-	10	-	-	10	-	-																		
	2nd	15	13	-	X	-	-	X	-	-																		
	3rd	X	15	-	X	-	-	X	-	-																		
-5	1st	8	8	-	8	-	-	8	-	-																		
	2nd	12	9	-	14	-	-	15	-	-																		
	3rd	X	11	-	X	-	-	X	-	-																		
-10	1st	5	3	-	6	-	-	7	-	-																		
	2nd	9	5	-	12	-	-	14	-	-																		
	3rd	13	7	-	X	-	-	X	-	-																		
-15	1st	2	-	-	4	-	-	6	-	-																		
	2nd	6	-	-	10	-	-	12	-	-																		
	3rd	10	3	-	X	-	-	X	-	-																		
-20	1st	1	-	-	3	-	-	5	-	-																		
	2nd	3	-	-	8	-	-	11	-	-																		
	3rd	7	-	-	14	-	-	X	-	-																		

VOLUME: 8,400 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE 13-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																													
		110			170			250			380			570			850			1300			1900			2900					
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd			
+20	1st	X	X	-	X	X	-	15	-																						
	2nd	X	X	-	X	X	-	X	-																						
	3rd	X	X	-	X	X	-	X	-																						
+15	1st	X	X	-	X	X	-	14	-																						
	2nd	X	X	-	X	X	-	X	-																						
	3rd	X	X	-	X	X	-	X	-																						
+10	1st	X	X	-	14	X	-	12	-																						
	2nd	X	X	-	X	X	-	X	-																						
	3rd	X	X	-	X	X	-	X	-																						
+5	1st	15	X	-	12	X	-	11	-																						
	2nd	X	X	-	X	X	-	X	-																						
	3rd	X	X	-	X	X	-	X	-																						
GROUND LEVEL	1st	12	12	-	10	12	-	10	-																						
	2nd	15	13	-	X	15	-	X	-																						
	3rd	X	15	-	X	X	-	X	-																						
-5	1st	9	8	-	8	8	8	9	-																						
	2nd	13	9	-	14	11	-	15	-																						
	3rd	X	11	-	X	14	-	X	-																						
-10	1st	6	4	-	7	5	-	7	-																						
	2nd	10	5	-	12	8	-	14	-																						
	3rd	14	7	-	X	11	-	X	-																						
-15	1st	3	1	-	5	2	-	6	-																						
	2nd	7	1	-	10	5	-	13	-																						
	3rd	11	3	-	X	8	-	X	-																						
-20	1st	1	1	-	3	-	-	5	-																						
	2nd	4	1	-	8	-	-	11	-																						
	3rd	8	1	-	14	4	-	X	-																						

VOLUME: 13,000 (VEH./DAY)

SPEED: 60 (M.P.H.)

%TRUCK: 10%

%GRADE: 0 to

VOLUME 13,000 (VEH/DAY) SPEED 60 (MPH) %TRUCK 10% %GRADE 0 to 3

TABLE 13-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																													
		110			170			250			380			570			850			1300			1900			2900					
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd			
+20	1st	X	X	X	X	X	-	15	X	-	2½L	-																			
	2nd	X	X	X	X	X	-	X	X	-	3L	-																			
	3rd	X	X	X	X	X	-	X	X	-	3½L	-																			
+15	1st	X	X	X	X	X	-	14	X	-	12	-																			
	2nd	X	X	X	X	X	-	X	X	-	3L	-																			
	3rd	X	X	X	X	X	-	X	X	-	3½L	-																			
+10	1st	X	X	X	15	X	-	13	X	-	11	-																			
	2nd	X	X	X	X	X	-	X	X	-	2½L	-																			
	3rd	X	X	X	X	X	-	X	X	-	3L	-																			
+5	1st	X	X	X	13	15	-	11	14	-	10	-																			
	2nd	X	X	X	X	X	-	X	X	-	2L	-																			
	3rd	X	X	X	X	X	-	X	X	-	2½L	-																			
GROUND LEVEL	1st	15	12	12	11	12	-	10	12	-	10	-																			
	2nd	X	14	13	X	X	-	X	X	-	2L	-																			
	3rd	X	15	14	X	X	-	X	X	-	2½L	-																			
-5	1st	12	8	8	9	9	-	9	9	-	9	-																			
	2nd	X	10	8	14	12	-	X	13	-	2L	-																			
	3rd	X	11	9	X	14	-	X	X	-	2L	-																			
-10	1st	9	4	3	7	5	-	8	7	-	8	-																			
	2nd	13	5	4	13	8	-	14	11	-	15	-																			
	3rd	X	7	-	X	11	-	X	15	-	2L	-																			
-15	1st	7	1	-	5	2	-	6	4	-	7	-																			
	2nd	10	1	-	11	5	-	13	8	-	14	-																			
	3rd	14	3	-	X	8	-	X	12	-	2L	-																			
-20	1st	4	1	-	3	1	-	5	-	-	6	-																			
	2nd	8	1	-	9	1	-	12	5	-	14	-																			
	3rd	12	1	-	14	4	-	X	10	-	2L	-																			

VOLUME: 19,000 (VEH./DAY)

SPEED: 60 (MPH)

%TRUCK: 10%

%GRADE: 0 TO

VOLUME 19,000 (VEH/DAY) SPEED 60 (MPH) %TRUCK 10% %GRADE 0 to 3



TABLE: 13-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+15	1st	X	X	X	X	X	X	X	X	-	12	2½L	-	11	2½L	-												
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	3L	-												
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-												
+10	1st	X	X	X	X	X	X	13	X	-	11	2½L	-	11	15	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	3L	-												
+5	1st	X	X	X	X	X	X	12	15	-	11	2L	-	10	13	-												
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-												
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	3L	-												
GROUND LEVEL	1st	X	12	12	14	12	13	10	12	-	10	12	-	9	11	-												
	2nd	X	14	13	X	15	14	X	X	-	2L	2L	-	2L	2L	-												
	3rd	X	X	14	X	X	X	X	X	-	2½L	2L	-	2½L	2½L	-												
-5	1st	15	8	8	12	9	9	9	9	-	9	10	-	9	10	-												
	2nd	X	10	8	X	10	10	X	14	-	2L	15	-	2L	2L	-												
	3rd	X	12	9	X	12	12	X	X	-	2L	2L	-	2L	2L	-												
-10	1st	12	4	3	10	4	4	8	7	-	8	8	-	8	8	-												
	2nd	X	6	4	15	6	6	14	11	-	15	13	-	2L	15	-												
	3rd	X	8	5	X	8	8	X	15	-	2L	2L	-	2L	2L	-												
-15	1st	10	1	1	8	-	-	6	4	-	7	6	-	8	7	-												
	2nd	14	2	1	14	2	2	13	8	-	15	11	-	2L	13	-												
	3rd	X	3	1	X	4	4	X	12	-	2L	2L	-	2L	2L	-												
-20	1st	7	1	1	6	-	-	5	1	-	6	4	-	7	5	-												
	2nd	11	1	1	12	-	-	12	6	-	14	9	-	15	12	-												
	3rd	15	1	1	X	-	-	X	10	-	2L	14	-	2L	2L	-												

VOLUME 28,000 (VEH/DAY) SPEED 60 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 13-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	2½L	10	10	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	3L	-						
+15	1st	X	X	X	X	X	X	X	X	X	13	2½L	3L	11	2½L	2½L	11	15	2½L	10	10	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-						
+10	1st	X	X	X	X	X	X	X	X	X	12	15	2½L	11	15	2½L	10	14	2L	10	10	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	3L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	-						
+5	1st	X	X	X	X	X	X	15	15	X	11	14	2L	10	13	15	10	12	15	9	9	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-						
GROUND LEVEL	1st	X	14	12	X	13	13	14	13	13	10	12	13	10	12	13	9	11	13	9	9	-						
	2nd	X	X	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	-						
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-						
-5	1st	X	10	8	X	10	9	13	10	10	10	10	9	9	11	9	10	11	9	9	9	-						
	2nd	X	12	8	X	12	11	X	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	13	10	X	15	12	X	X	15	2L	2L	2L	2L	2L	2L	3L	2½L	2½L	3L	3L	-						
-10	1st	X	6	3	14	6	5	11	7	6	9	8	7	9	9	9	9	9	9	9	9	-						
	2nd	X	8	4	X	9	6	X	12	10	2L	14	11	2L	2L	13	2L	2L	2L	2L	2L	-						
	3rd	X	9	5	X	12	8	X	X	12	2L	2L	15	2L	2L	2L	2½L	2½L	2L	3L	3L	-						
-15	1st	13	2	1	12	3	1	10	5	3	8	6	5	8	8	6	8	8	8	8	8	-						
	2nd	X	3	1	X	6	2	X	9	5	15	12	8	2L	2L	11	2L	2L	2L	2L	2L	-						
	3rd	X	5	1	X	9	4	X	13	8	2L	2L	12	2L	2L	2L	2½L	2L	2L	3L	3L	-						
-20	1st	10	1	1	10	1	1	9	2	1	7	4	2	7	7	4	8	7	6	8	8	-						
	2nd	14	1	1	15	2	1	15	6	2	15	10	5	15	15	9	2L	2L	2L	2L	2L	-						
	3rd	X	1	1	X	5	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	2½L	-						

VOLUME 43,000 (VEH/DAY) SPEED 60 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 13-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																													
		110			170			250			380			570			850			1300			1900			2900					
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3L	3L	3½L	13	2½L	3L	11	2½L	2½L	10	14	2½L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3L	3½L	4L	3½L	3½L	-						
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	12	2½L	2½L	11	15	2½L	10	14	2½L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-						
+10	1st	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	11	15	2½L	10	14	2L	10	13	2L	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-						
+5	1st	X	X	X	X	X	X	X	X	X	15	15	2L	11	14	2L	10	13	15	10	12	14	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3½L	-						
GROUND LEVEL	1st	X	X	13	X	X	13	X	14	14	14	13	14	10	12	14	10	12	13	9	11	13	9	11	-						
	2nd	X	X	14	X	X	15	X	X	X	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	15	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-						
-5	1st	X	14	8	X	13	9	X	12	10	13	11	11	10	11	11	9	11	12	9	11	12	9	11	-						
	2nd	X	X	9	X	X	11	X	X	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	X	10	X	X	13	X	X	X	2½L	2L	2L	2½L	2½L	2L	3L	2L	2L	3L	3L	3L	3L	3L	-						
-10	1st	X	10	4	X	10	5	15	9	7	12	9	8	9	9	9	9	10	10	9	10	10	9	10	-						
	2nd	X	12	5	X	13	7	X	13	10	2L	14	12	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	14	6	X	9	X	X	12	2L	2L	15	2½L	2L	2L	2L	2½L	2½L	3L	3L	3L	3L	3L	3L	-						
-15	1st	X	6	1	X	6	1	14	6	3	11	7	5	9	8	7	9	9	8	9	9	9	9	10	-						
	2nd	X	8	1	X	9	3	X	10	6	2L	12	9	2L	14	12	2L	2L	14	2L	2L	2L	2L	2L	-						
	3rd	X	4	1	X	12	5	X	15	9	2L	2L	13	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	-						
-20	1st	15	2	1	14	3	1	13	4	1	10	5	2	8	6	4	8	8	6	8	8	8	8	9	-						
	2nd	X	4	1	X	6	1	X	8	2	2L	10	6	2L	13	9	2L	15	12	2L	2L	2L	2L	2L	-						
	3rd	X	5	1	X	9	1	X	12	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2L	2L	3L	3L	-						

VOLUME: 64,000 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 0 to 3

TABLE: 13-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											VOLUME 96,000 (VEH./DAY)	SPEED 60 (MP.H.)	% TRUCK 10%	% GRADE 0 to 3
		110			170			250			380			570			850			1300			1900			2900						
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd				
+20	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3L	3L	3L	13	2½L	3L	11	15	2½L	10	14	2½L	10	13	2L				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L				
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	4L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	4L				
+15	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	3L	12	2½L	2½L	11	14	2½L	10	13	2L	9	12	15				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L				
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	2½L	3½L	3½L	3½L	3½L	3½L	3½L				
+10	1st	X	X	X	X	X	X	X	X	X	3½L	3½L	3L	3L	2½L	2½L	12	15	2½L	10	14	2L	10	13	15	9	12	14				
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L					
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L				
+5	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	2½L	2½L	2L	11	14	2L	10	13	15	10	12	14	9	12	14				
	2nd	X	X	X	X	X	X	X	X	X	2½L	3L	2½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L				
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L				
GROUND LEVEL	1st	X	X	15	X	X	X	X	X	X	3L	2½L	15	2½L	2L	15	11	13	14	10	12	14	9	12	13	9	11	13				
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L				
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	4L	3L	2½L	3½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L				
-5	1st	X	X	10	X	X	12	X	X	13	2½L	2L	13	2½L	15	13	11	12	13	10	11	13	9	11	12	9	11	12				
	2nd	X	X	10	X	X	14	X	X	15	3L	2½L	2L	3L	2½L	2L	2½L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L				
	3rd	X	X	12	X	X	15	X	X	X	3½L	3L	2L	3½L	3L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L				
-10	1st	X	X	6	X	X	8	X	X	9	2½L	2L	10	15	13	10	10	11	11	9	11	11	9L	11	12	9	10	12				
	2nd	X	X	7	X	X	10	X	X	12	3L	2L	13	3L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L					
	3rd	X	X	8	X	X	11	X	X	X	3½L	2½L	2L	3½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L				
-15	1st	X	10	1	X	14	4	X	X	6	2L	2L	7	15	12	9	10	10	9	9	10	10	9L	10	11	9	10	11				
	2nd	X	12	2	X	X	6	X	X	8	2½L	2L	11	2½L	2L	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L					
	3rd	X	13	3	X	X	7	X	X	11	3L	2L	14	3L	2L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L					
-20	1st	X	6	1	X	11	2	X	13	2	2L	13	4	14	10	6	8	9	7	9	9	9	9	10	10	9	10	10				
	2nd	X	8	1	X	14	2	X	X	5	2L	2L	8	2½L	2L	11	2L	2L	13	2L	2L	15	2L	2L	2L	2L	2L					
	3rd	X	9	1	X	X	3	X	X	8	2½L	2L	12	3L	2L	15	3½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L				



TABLE: 13-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5L	4½	4½	4L	4L	4L	3L	3L	3L	12	2½	2½	10	14	2½	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5½	5L	4½	4½	4½	4L	4L	4L	3½	3L	3L	3½	2½	3L	3L	2½	2½	3L
	3rd	X	X	X	X	X	X	X	X	X	5½	5½	5L	5½	5L	4½	4½	4½	4L	3½	4L	4L	3½	3½	4L	3½	3½	4L
+15	1st	X	X	X	X	X	X	X	X	X	4½	4½	4L	4L	4L	3½	3L	3L	12	2L	2½	10	14	2L	10	13	2L	
	2nd	X	X	X	X	X	X	X	X	X	5L	4½	4L	4L	4½	4L	3½	3½	3L	3L	3L	2½	3L	3L	2½	2½	3L	
	3rd	X	X	X	X	X	X	X	X	X	5½	5L	4½	5L	5L	4½	4½	4½	4L	3½	3½	4L	3½	3½	3½	3½	3½	3½
+10	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½	3½	3½	3L	3L	3L	2½	11	15	2½	10	13	2L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½	4½	3½	4L	4L	3½	3½	3½	3L	2½	3L	3L	2½	2½	3L	2½	2½	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½	4L	5L	4½	3L	4½	4L	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½
+5	1st	X	X	X	X	X	X	X	X	X	4L	3½	3L	3½	3½	3L	2½	2½	2½	11	14	2L	10	13	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4½	4L	3L	4L	4L	3L	3½	3½	3L	2½	2½	3L	2½	2½	2½	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½	4½	4½	3½	4L	4L	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½	3L	2½	3L	3L	2½	2½	2L	11	13	15	10	12	14	9	12	14	
	2nd	X	X	X	X	X	X	X	X	X	4L	3½	3L	4L	3½	3L	3½	3L	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	4½	4L	3L	4½	4L	3L	4L	4L	3L	3½	3½	3L	3½	3½	3½	3½	3½	3½
-5	1st	X	X	15	X	X	X	X	X	X	3½	3L	2L	3L	3L	2L	2½	2½	14	11	13	14	10	12	13	9	11	13
	2nd	X	X	15	X	X	X	X	X	X	4L	3L	2½	3½	3½	2½	3L	3L	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	4L	3½	2½	4½	4L	3L	4L	3½	3L	3½	3L	3½	3L	3½	3L	3½	3L	3½
-10	1st	X	X	10	X	X	14	X	X	X	3L	2½	2L	3L	2½	2L	2½	2L	12	11	12	12	9	11	12	9	11	12
	2nd	X	X	10	X	X	X	X	X	X	3½	3L	2L	3½	3L	2L	3L	2½	2L	2½	2½	2L	2½	2½	2½	2½	2½	2½
	3rd	X	X	12	X	X	X	X	X	X	4L	3L	2L	4L	3½	2½	4L	3½	3L	3L	3L	3L	3½	3½	3½	3L	3½	3L
-15	1st	X	14	6	X	X	10	X	X	13	2½	2L	15	2½	2½	14	2L	2L	11	10	11	11	9	11	11	9	11	12
	2nd	X	X	7	X	X	12	X	X	X	3L	2½	2L	3½	3L	2L	3L	2½	2L	2½	2L	2½	2½	2L	2½	2½	2½	
	3rd	X	X	7	X	X	14	X	X	X	3½	2½	2L	4L	3½	2L	3½	3L	2½	3L	3L	2½	3L	3L	3L	3L	3L	3L
-20	1st	X	10	1	X	X	6	X	X	10	2½	2L	12	2½	2L	12	15	15	10	10	10	9	10	10	9	10	11	
	2nd	X	12	2	X	X	8	X	X	13	3L	2L	2L	3L	2½	2L	3L	2½	2L	2L	2L	2L	2L	2L	2L	2L	2L	
	3rd	X	14	3	X	X	9	X	X	15	3½	2½	2L	3½	3L	2L	3½	3L	2½	3L	3L	2½	3L	3L	3L	3L	3L	3L

VOLUME 140,000 (VEH./DAY)

SPEED 60 (MPH)

%TRUCK 10%

%GRADE 0 to

VOLUME 140,000 (VEH./DAY) SPEED: 60 (MPH) % TRUCK: 10% % GRADE: 0 to 3

TABLE: 13-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20		1st	X	X	X	X	X	X	X	X	X	6L	6L	5½L	5L	5½L	5½L	4L	4½L	5L	3½L	4L	3½L	14	2½L	2½L	11	14	2½L
		2nd	X	X	X	X	X	X	X	X	6½L	6L	5½L	6L	6L	5½L	5L	5½L	5½L	4L	4½L	4½L	3½L	3½L	3½L	2½L	3L	3L	
		3rd	X	X	X	X	X	X	X	X	7L	6½L	6L	6½L	6½L	6L	6L	6L	6L	5L	5½L	5L	4L	4L	4L	3½L	4L	4L	
+15		1st	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5L	5L	4L	4½L	4L	3½L	3½L	3½L	14	2½L	2½L	10	14	2½L	
		2nd	X	X	X	X	X	X	X	X	6½L	6L	5L	5½L	5½L	5L	5L	5L	4L	4L	4L	3L	3½L	3½L	2½L	3L	3L		
		3rd	X	X	X	X	X	X	X	X	7L	6L	5½L	6½L	6L	5½L	5½L	6L	5½L	5L	5L	4L	4L	4L	3½L	3½L	4L		
+10		1st	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4L	4½L	4½L	3L	3½L	3½L	14	2½L	2½L	10	13	2L
		2nd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	5L	4L	4½L	4L	3L	3L	3L	2½L	3L	3L	
		3rd	X	X	X	X	X	X	X	X	X	6½L	6L	5L	6L	6L	5½L	5½L	5½L	5L	5L	5L	4L	4L	4L	3½L	3½L	4L	
+5		1st	X	X	X	X	X	X	X	X	X	5½L	5L	4L	4½L	4½L	4½L	4L	4L	4L	3L	3½L	3½L	14	2½L	2½L	10	13	2L
		2nd	X	X	X	X	X	X	X	X	X	6L	5L	4½L	5L	5L	4½L	4½L	5L	4½L	4L	4L	3L	3L	3L	2½L	3L	3L	
		3rd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6L	5½L	5L	5½L	5L	5L	5L	4L	4L	3L	4L	4L	3½L	3½L	3½L
GROUND LEVEL		1st	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4½L	4L	3½L	4L	4L	3L	3½L	3L	14	2L	2L	10	13	15
		2nd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	5L	4½L	4½L	4½L	4L	4L	4L	3L	3L	3L	2½L	2½L	3L	
		3rd	X	X	X	X	X	X	X	X	X	6L	5L	4L	6L	5½L	4½L	5½L	5L	5L	4½L	5L	4½L	4L	4L	4L	3½L	3½L	3½L
-5		1st	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3L	14	2L	2L	10	12	14
		2nd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	5L	4½L	4L	4½L	4½L	4½L	4L	4L	3½L	3L	3L	2½L	2½L	2½L	
		3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5½L	5L	4½L	5L	5L	4½L	4½L	3½L	4L	3½L	3L	3L	3L	3L	3L
-10		1st	X	X	X	X	X	X	X	X	X	4½L	3½L	3L	4L	4L	3½L	3½L	3½L	3L	3L	3L	13	15	15	10	12	14	
		2nd	X	X	X	X	X	X	X	X	X	5L	4L	3L	4½L	4½L	3½L	4½L	4L	4L	3½L	4L	3½L	3L	2½L	2½L	2½L	2½L	
		3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3L	5½L	5L	4L	5L	5L	4½L	4½L	4½L	4L	4L	3½L	3½L	3½L	3½L	3½L
-15		1st	X	X	12	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3L	3L	3L	2½L	13	14	14	10	12	13
		2nd	X	X	13	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	
		3rd	X	X	14	X	X	X	X	X	X	5L	4L	3L	5L	4½L	3½L	5L	4½L	4L	4½L	4½L	4L	4L	3½L	3½L	3½L	3½L	3½L
-20		1st	X	X	7	X	X	14	X	X	X	4L	3L	2L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L	13	13	13	10	11	12	
		2nd	X	X	8	X	X	X	X	X	X	4½L	3L	2L	4½L	4L	3L	4L	4L	3½L	3½L	3L	3L	2½L	2½L	2½L	2½L	2½L	
		3rd	X	X	9	X	X	X	X	X	X	5L	3½L	2½L	4½L	4L	3L	5L	4½L	4L	4½L	4½L	3½L	4L	3L	3L	3½L	3½L	3L

VOLUME 220, 000  
(VEH/ DAY)

SPEED 60  
M.P.H)

% TRUCK 10%

% GRADE 0 to

TABLE: 14-1

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	-																										
	2nd	X	-																										
	3rd	X	-																										
+15	1st	X	-																										
	2nd	X	-																										
	3rd	X	-																										
+10	1st	X	-																										
	2nd	X	-																										
	3rd	X	-																										
+5	1st	13	-																										
	2nd	14	-																										
	3rd	X	-																										
GROUND LEVEL	1st	10	-																										
	2nd	14	-																										
	3rd	X	-																										
-5	1st	8	-																										
	2nd	11	-																										
	3rd	15	-																										
-10	1st	5	-																										
	2nd	8	-																										
	3rd	12	-																										
-15	1st	2	-																										
	2nd	6	-																										
	3rd	9	-																										
-20	1st	X	-																										
	2nd	3	-																										
	3rd	7	-																										

VOLUME: 2,500  
(VEH/DAY)  
  
SPEED: 60  
(MPH)  
  
%TRUCK: 10%  
  
%GRADE: 4 to

VOLUME: 2,500

(VEH/DAY)

SPEED: 60 (MPH)

%TRUCK: 10%

%GRADE: 4 to 6

TABLE: 14-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+15	1st	X	X	X	X	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+10	1st	X	X	X	X	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+5	1st	14	X	X	13	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
GROUND LEVEL	1st	11	X	X	10	-																						
	2nd	14	X	X	15	-																						
	3rd	X	X	X	X	-																						
-5	1st	8	X	X	8	-																						
	2nd	12	X	X	14	-																						
	3rd	15	X	X	X	-																						
-10	1st	5	X	X	6	-																						
	2nd	9	X	X	12	-																						
	3rd	12	X	X	X	-																						
-15	1st	2	X	X	4	-																						
	2nd	6	X	X	10	-																						
	3rd	10	X	X	15	-																						
-20	1st	1	X	X	2	-																						
	2nd	3	X	X	8	-																						
	3rd	10	X	X	13	-																						

VOLUME: 3,800

(VEH/DAY)

SPEED: 60 (MPH)

%TRUCK: 10%

%GRADE: 4 to 6

TABLE: 14-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	-	-																					
	2nd	X	X	X	X	-	-																					
	3rd	X	X	X	X	-	-																					
+15	1st	X	X	X	X	-	-																					
	2nd	X	X	X	X	-	-																					
	3rd	X	X	X	X	-	-																					
+10	1st	X	X	X	14	-	-																					
	2nd	X	X	X	X	-	-																					
	3rd	X	X	X	X	-	-																					
+5	1st	14	X	X	12	-	-																					
	2nd	X	X	X	X	-	-																					
	3rd	X	X	X	X	-	-																					
GROUND LEVEL	1st	11	X	X	10	-	-																					
	2nd	15	X	X	X	-	-																					
	3rd	X	X	X	X	-	-																					
-5	1st	8	X	X	8	-	-																					
	2nd	12	X	X	14	-	-																					
	3rd	15	X	X	X	-	-																					
-10	1st	5	X	X	6	-	-																					
	2nd	9	X	X	12	-	-																					
	3rd	13	X	X	X	-	-																					
-15	1st	2	X	X	4	-	-																					
	2nd	7	X	X	10	-	-																					
	3rd	10	X	X	15	-	-																					
-20	1st	1	X	X	2	-	-																					
	2nd	3	X	X	8	-	-																					
	3rd	7	X	X	13	-	-																					

VOLUME: 5,600 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 14-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	-	-																		
	2nd	X	X	X	X	X	X	X	-	-																		
	3rd	X	X	X	X	X	X	X	-	-																		
+15	1st	X	X	X	X	X	X	14	-	-																		
	2nd	X	X	X	X	X	X	X	-	-																		
	3rd	X	X	X	X	X	X	X	-	-																		
+10	1st	X	X	X	14	X	X	12	-	-																		
	2nd	X	X	X	X	X	X	X	-	-																		
	3rd	X	X	X	X	X	X	X	-	-																		
+5	1st	14	12	X	12	X	X	11	-	-																		
	2nd	X	13	X	X	X	X	X	-	-																		
	3rd	X	15	X	X	X	X	X	-	-																		
GROUND LEVEL	1st	11	12	X	10	X	X	10	-	-																		
	2nd	15	13	X	X	X	X	X	-	-																		
	3rd	X	15	X	X	X	X	X	-	-																		
-5	1st	8	8	X	8	X	X	8	-	-																		
	2nd	12	9	X	14	X	X	15	-	-																		
	3rd	X	11	X	X	X	X	X	-	-																		
-10	1st	5	4	X	6	X	X	7	-	-																		
	2nd	9	5	X	12	X	X	14	-	-																		
	3rd	13	7	X	X	X	X	X	-	-																		
-15	1st	2	X	X	4	X	X	6	-	-																		
	2nd	6	X	X	10	X	X	12	-	-																		
	3rd	10	3	X	X	X	X	X	-	-																		
-20	1st	1	X	X	3	X	X	5	-	-																		
	2nd	3	X	X	8	X	X	11	-	-																		
	3rd	7	X	X	14	X	X	X	-	-																		

VOLUME: 8,400 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 14-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	X	13	-																
	2nd	X	X	X	X	X	X	X	X	X	3L	-																
	3rd	X	X	X	X	X	X	X	X	X	3½L	-																
+15	1st	X	X	X	X	X	X	14	X	X	12	-																
	2nd	X	X	X	X	X	X	X	X	X	3L	-																
	3rd	X	X	X	X	X	X	X	X	X	3½L	-																
+10	1st	X	X	X	14	14	X	12	X	X	10	-																
	2nd	X	X	X	X	X	X	X	X	X	2½L	-																
	3rd	X	X	X	X	X	X	X	X	X	3L	-																
+5	1st	X	X	X	13	15	X	11	X	X	10	-																
	2nd	X	X	X	X	X	X	X	X	X	2L	-																
	3rd	X	X	X	X	X	X	X	X	X	2½L	-																
GROUND LEVEL	1st	14	12	X	11	12	X	10	X	X	9	-																
	2nd	X	14	X	X	15	X	X	X	X	2L	-																
	3rd	X	15	X	X	X	X	X	X	X	2½L	-																
-5	1st	11	8	X	9	8	X	9	X	X	9	-																
	2nd	14	9	X	14	11	X	15	X	X	2L	-																
	3rd	X	11	X	X	14	X	X	X	X	2L	-																
-10	1st	8	4	X	7	5	X	7	X	X	8	-																
	2nd	12	5	X	12	8	X	14	X	X	15	-																
	3rd	15	7	X	X	11	X	X	X	X	2L	-																
-15	1st	5	1	X	5	2	X	6	X	X	7	-																
	2nd	9	1	X	10	5	X	13	X	X	14	-																
	3rd	13	3	X	X	8	X	X	X	X	2L	-																
-20	1st	2	1	X	3	X	X	5	X	X	6	-																
	2nd	6	1	X	8	X	X	11	X	X	13	-																
	3rd	10	1	X	14	4	X	X	X	X	2L	-																

VOLUME: 13,000 (VEH./DAY)

SPEED: 60 (M.P.H.)

%TRUCK: 10%

%GRADE: 4 to 6

VOLUME: 13,000 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 14-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																													
		110			170			250			380			570			850			1300			1900			2900					
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20		1st	X	X	X	X	X	X	15	X	X	13	3L	-																	
		2nd	X	X	X	X	X	X	X	X	X	3L	3½L	-																	
		3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	-																	
+15		1st	X	X	X	X	X	X	14	X	X	12	2L	-																	
		2nd	X	X	X	X	X	X	X	X	X	3L	3L	-																	
		3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	-																	
+10		1st	X	X	X	15	X	X	13	X	X	11	15	-																	
		2nd	X	X	X	X	X	X	X	X	X	2½L	2L	-																	
		3rd	X	X	X	X	X	X	X	X	X	3L	2L	-																	
+5		1st	X	X	X	13	15	X	11	14	X	10	14	-																	
		2nd	X	X	X	X	X	X	X	X	X	2½L	2L	-																	
		3rd	X	X	X	X	X	X	X	X	X	3L	2L	-																	
GROUND LEVEL		1st	X	12	12	12	12	12	10	12	X	10	12	-																	
		2nd	X	14	13	X	15	14	X	X	X	2L	2L	-																	
		3rd	X	15	14	X	X	X	X	X	X	2½L	2L	-																	
-5		1st	14	8	8	10	9	8	9	9	X	9	10	-																	
		2nd	X	10	8	15	12	10	X	13	X	2L	15	-																	
		3rd	X	11	9	X	15	12	X	X	X	2L	2L	-																	
-10		1st	11	4	3	8	5	4	8	7	X	8	8	-																	
		2nd	15	6	4	13	8	6	14	11	X	15	13	-																	
		3rd	X	7	5	X	11	8	X	15	X	2L	2L	-																	
-15		1st	8	1	X	6	2	X	6	4	X	7	6	-																	
		2nd	12	2	X	11	5	2	13	8	X	15	11	-																	
		3rd	X	3	X	X	8	4	X	12	X	2L	2L	-																	
-20		1st	5	1	X	5	1	X	5	X	X	6	4	-																	
		2nd	9	1	X	9	2	X	12	6	X	14	9	-																	
		3rd	13	1	X	15	5	X	X	10	X	2L	14	-																	

VOLUME: 19,000 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 4 to 6



TABLE: 14-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	13	3L	3L	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	15	X	X	12	2½L	3L	11	2½L	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	13	X	X	12	15	2½L	11	15	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	12	15	X	11	14	X	10	13	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2L	2L	2½L	2½L	2½L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	13	X	X	2½L	2½L	2½L	3L	3L	-	2L	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	X	12	13	11	12	13	10	12	13	9	11	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-5	1st	15	8	8	14	9	9	9	9	9	9	10	10	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	12	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-10	1st	12	4	3	12	6	5	8	7	6	8	8	7	8	9	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	6	4	X	9	6	15	11	10	2L	13	11	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	12	8	X	15	11	2L	2L	15	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-15	1st	10	1	1	10	2	1	7	4	2	7	6	4	8	7	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	14	2	1	15	9	2	13	8	5	15	11	8	2L	13	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	1	X	8	4	X	13	8	2L	2L	12	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-20	1st	7	1	1	8	1	1	5	2	X	6	4	2L	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	11	1	1	14	2	1	12	8	2	14	9	5	15	12	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	15	1	1	X	5	1	X	10	4	2L	15	9	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-

VOLUME: 28,000 (VEH/DAY) SPEED: 60 (M.P.H.) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 14-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	15	3L	3½L	12	2½L	3L	11	2½L	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	2½L	2½L	3L	3½L	2½L	3L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	3½L	-						
+15	1st	X	X	X	X	X	X	X	X	X	14	2½L	3L	12	2½L	2½L	11	15	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	2½L	3L	2½L	3L	2½L	3L	-					
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-					
+10	1st	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	11	15	2½L	10	14	2L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	2½L	3½L	3½L	-						
+5	1st	X	X	X	X	X	X	X	X	X	2L	2L	2L	11	14	2L	10	13	15	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-						
GROUND LEVEL	1st	X	14	12	X	14	13	X	13	13	11	13	13	10	12	13	10	12	13	9	11	-						
	2nd	X	X	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	14	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-						
-5	1st	X	10	8	X	10	9	15	10	10	10	11	11	9	11	11	9	11	11	9	11	-						
	2nd	X	12	8	X	13	11	X	15	13	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	13	10	X	X	12	X	X	15	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	-						
-10	1st	X	6	3	X	7	5	13	8	6	10	9	8	9	9	9	9	10	10	9	10	-						
	2nd	X	8	4	X	10	7	X	12	10	2L	14	11	2L	15	14	2L	2L	2L	2L	2L	-						
	3rd	X	9	5	X	13	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	3L	-						
-15	1st	13	2	1	14	4	1	12	5	3	9	7	5	8	8	6	8	8	8	8	9	-						
	2nd	X	3	1	X	7	2	X	9	6	2L	12	9	2L	14	11	2L	2L	14	2L	2L	-						
	3rd	X	5	1	X	10	4	X	14	8	2L	2L	12	2L	2L	2L	2½L	2½L	2L	3L	2½L	-						
-20	1st	10	1	1	12	1	1	11	3	1	8	5	2	8	6	4	8	7	6	8	8	-						
	2nd	14	1	1	X	3	1	X	7	2	15	10	6	2L	13	9	2L	14	12	2L	2L	-						
	3rd	X	1	1	X	6	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	2½L	-						

VOLUME: 43,000 (VEH./DAY)

SPEED: 60 (M.P.H.)

% TRUCK: 10%

% GRADE: 4.00

TABLE: 14-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3½L	3L	3½L	13	2½L	3L	11	2½L	3L	10	15	2½L	10	10	2L	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	4L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	4L	-	-	-
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	13	2½L	3L	11	15	2½L	10	14	2½L	10	10	2L	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-
+10	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	12	2L	2½L	11	14	2½L	10	13	2L	9	9	15	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-
+5	1st	X	X	X	X	X	X	X	X	X	2½L	2L	2L	12	14	2L	13	15	10	12	15	9	9	14	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	2½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	-	-	-
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	14	2½L	14	14	11	13	14	10	12	14	9	12	13	9	9	13	-	-	-
	2nd	X	X	14	X	X	15	X	X	X	3L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-
	3rd	X	X	15	X	X	X	X	X	X	3½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-	-	-
-5	1st	X	14	8	X	X	10	X	15	10	15	12	11	11	12	10	11	12	9	11	12	9	11	12	-	-	-	-
	2nd	X	X	9	X	X	11	X	13	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	X	10	X	X	13	X	X	X	3L	2L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	-	-	-
-10	1st	X	10	4	X	12	5	X	12	7	14	10	8	10	10	9	9	10	10	9	10	11	9	10	11	-	-	-
	2nd	X	12	5	X	15	7	X	X	10	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	14	6	X	X	9	X	X	12	2½L	2L	2L	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	-	-	-
-15	1st	X	6	1	X	9	1	X	10	3	13	6	5	9	8	7	9	9	8	9	9	9	9	10	10	-	-	-
	2nd	X	8	1	X	12	3	X	14	6	2L	13	9	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	10	1	X	15	5	X	X	9	2½L	2L	13	2½L	2L	2L	2L	2½L	2L	3L	2½L	2½L	3L	3L	3L	-	-	-
-20	1st	15	2	1	X	6	1	15	7	1	13	6	2	9	7	5	8	8	7	8	9	8	8	9	9	-	-	-
	2nd	X	4	1	X	9	1	X	11	3	2L	11	6	2L	13	10	2L	15	12	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	5	1	X	12	1	X	X	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	-	-	-

VOLUME: 64,000 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 14-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	3½L	3½L	3½L	15	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L	
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	4½L	4L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L
+15	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3½L	3½L	3L	15	2½L	3L	11	15	2½L	10	13	2L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	3½L	4L	4L	3½L	3L	2½L	3L	2L	3L	3L	2½L	2½L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+10	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	2½L	15	2½L	2½L	11	14	2½L	10	13	2L	9	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	2½L	14	15	2L	10	13	2L	10	12	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4L	2½L	3L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2L	14	14	15	10	13	14	10	12	14	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	13	X	X	15	X	X	X	3L	2½L	2L	2½L	2½L	14	13	13	13	10	12	13	9	11	13	9	11	13
	2nd	X	X	14	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	14	X	X	X	X	X	X	4L	3L	2L	4L	3½L	2½L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-10	1st	X	X	8	X	X	11	X	X	13	2½L	2L	13	2½L	2L	12	13	13	12	10	11	12	9	11	12	9	11	12
	2nd	X	X	9	X	X	13	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	10	X	X	15	X	X	X	3½L	2½L	2L	4L	3L	2L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-15	1st	X	12	3	X	X	8	X	X	10	2½L	2L	10	2½L	2L	9	13	11	10	9	10	10	9	10	11	9	10	11
	2nd	X	14	4	X	X	9	X	X	13	3L	2L	14	3L	2½L	14	2½L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L
	3rd	X	15	5	X	X	11	X	X	15	3½L	2½L	2L	3½L	3L	2L	3½L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L
-20	1st	X	8	1	X	13	3	X	X	6	2L	2L	7	2L	15	7	12	10	8	9	10	9	9	10	10	9	10	11
	2nd	X	10	1	X	X	5	X	X	9	2½L	2L	11	2½L	2L	12	2½L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	2L
	3rd	X	11	1	X	X	7	X	X	12	3L	2L	15	3½L	2½L	2L	3L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L



TABLE: 14-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																																
		110									170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd			
+20	1st	X	X	X	X	X	X	X	X	X	5L	5L	4 1/2L	4 1/2L	4 1/2L	4 1/2L	3 1/2L	3 1/2L	3 1/2L	15	2 1/2L	3L	11	15	2 1/2L	10	13	2L						
	2nd	X	X	X	X	X	X	X	X	X	5 1/2L	5 1/2L	5L	5L	5L	4 1/2L	4L	4 1/2L	4L	3 1/2L	3 1/2L	3 1/2L	2 1/2L	3L	3L	2 1/2L	3L	3L						
	3rd	X	X	X	X	X	X	X	X	X	6L	5 1/2L	5L	5 1/2L	5 1/2L	5L	5L	5L	5L	4L	4L	4L	3 1/2L	4L	4L	3 1/2L	3 1/2L	4L						
+15	1st	X	X	X	X	X	X	X	X	X	5L	4 1/2L	4L	4L	4 1/2L	4L	3 1/2L	3 1/2L	3 1/2L	15	2 1/2L	2 1/2L	11	14	2L	10	13	2L						
	2nd	X	X	X	X	X	X	X	X	X	5 1/2L	5L	4 1/2L	5L	5L	4 1/2L	4L	4L	4L	3 1/2L	3L	3 1/2L	2 1/2L	3L	3L	2 1/2L	2 1/2L	3L						
	3rd	X	X	X	X	X	X	X	X	X	6L	5 1/2L	4 1/2L	5 1/2L	5 1/2L	5L	5L	5L	4 1/2L	4L	4L	4L	3 1/2L	3 1/2L	4L	3 1/2L	3 1/2L	4L						
+10	1st	X	X	X	X	X	X	X	X	X	4 1/2L	4 1/2L	4L	4L	4L	3 1/2L	3L	3 1/2L	3L	14	2 1/2L	2 1/2L	11	14	2L	10	13	15						
	2nd	X	X	X	X	X	X	X	X	X	5L	5L	4L	4 1/2L	4 1/2L	4L	4L	4L	3 1/2L	3L	3L	3L	2 1/2L	3L	3L	2 1/2L	2 1/2L	3L						
	3rd	X	X	X	X	X	X	X	X	X	5 1/2L	5 1/2L	4 1/2L	5 1/2L	5L	4 1/2L	5L	4 1/2L	4L	4L	4L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L						
+5	1st	X	X	X	X	X	X	X	X	X	4 1/2L	4L	3 1/2L	4L	5 1/2L	3 1/2L	3L	3L	3L	14	2L	2L	10	13	2L	10	12	15						
	2nd	X	X	X	X	X	X	X	X	X	5L	4 1/2L	3 1/2L	4 1/2L	4 1/2L	3 1/2L	4L	4L	3 1/2L	3L	3L	3L	2 1/2L	2 1/2L	3L	2 1/2L	2 1/2L							
	3rd	X	X	X	X	X	X	X	X	X	5 1/2L	4 1/2L	4L	5L	5L	4L	4 1/2L	4 1/2L	4L	4L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L							
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	4L	3 1/2L	3L	3 1/2L	3 1/2L	3L	3L	3L	2 1/2L	14	15	15	10	13	15	10	12	14						
	2nd	X	X	X	X	X	X	X	X	X	4 1/2L	4L	3L	4L	4L	3 1/2L	3 1/2L	3 1/2L	3L	3L	3L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L							
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3 1/2L	5L	4 1/2L	4L	4 1/2L	4 1/2L	3 1/2L	4L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L							
-5	1st	X	X	X	X	X	X	X	X	X	3 1/2L	3L	2 1/2L	3 1/2L	2 1/2L	2 1/2L	3L	3L	2 1/2L	14	15	15	10	12	14	9	12	13						
	2nd	X	X	X	X	X	X	X	X	X	4L	3 1/2L	2 1/2L	4L	3L	3L	3 1/2L	3 1/2L	3L	3L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L							
	3rd	X	X	X	X	X	X	X	X	X	4 1/2L	4L	3L	3 1/2L	3 1/2L	3 1/2L	4 1/2L	4L	3 1/2L	4L	3 1/2L	3L	3 1/2L	3 1/2L	3 1/2L	3 1/2L	3 1/2L							
-10	1st	X	X	12	X	X	X	X	X	X	3 1/2L	3L	2L	3L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2L	13	14	13	10	12	13	9	11	13						
	2nd	X	X	13	X	X	X	X	X	X	4L	3L	2 1/2L	4L	2 1/2L	2 1/2L	3 1/2L	3 1/2L	2 1/2L	3L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L							
	3rd	X	X	14	X	X	X	X	X	X	4 1/2L	3 1/2L	2 1/2L	4 1/2L	3L	3L	4 1/2L	4L	3L	3 1/2L	3 1/2L	3L	3 1/2L	3L	3L	3 1/2L	3 1/2L							
-15	1st	X	X	7	X	X	13	X	X	X	3L	2 1/2L	2L	3L	2L	2L	2 1/2L	2 1/2L	2L	13	13	12	10	11	12	9	11	12						
	2nd	X	X	8	X	X	14	X	X	X	3 1/2L	2 1/2L	2L	3 1/2L	2 1/2L	2 1/2L	3 1/2L	3L	2 1/2L	3L	2 1/2L	2L	2 1/2L	2 1/2L	2 1/2L	2 1/2L								
	3rd	X	X	9	X	X	X	X	X	X	4L	3L	2L	4 1/2L	3L	3L	4L	3 1/2L	3L	3 1/2L	3L	3L	3L	3L	3L	3L	3L							
-20	1st	X	13	3	X	X	9	X	X	X	3L	2L	2L	3L	2L	2L	2 1/2L	2L	14	13	12	11	9	11	11	9	10	11						
	2nd	X	15	4	X	X	10	X	X	X	3 1/2L	2 1/2L	2L	3 1/2L	2L	2L	3L	3L	2L	2 1/2L	2 1/2L	2L	2 1/2L	2L	2L	2 1/2L	2 1/2L							
	3rd	X	X	5	X	X	12	X	X	X	3 1/2L	2 1/2L	2L	4L	2 1/2L	2 1/2L	4L	3 1/2L	2 1/2L	3 1/2L	3L	2 1/2L	3L	3L	3L	3L	3L							

VOLUME: 140,000 (VEH./DAY)

SPEED: 60 (MPH)

%TRUCK: 10%

%GRADE: 4 TO 6

VOLUME: 140,000 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 4 to 6

TABLE: 14-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	7L	6½L	6L	6L	6L	4½L	5L	5½L	3½L	4½L	4½L	3L	3½L	3½L	11	15	2½L	
	2nd	X	X	X	X	X	X	X	X	X	6½L	6L	6½L	6½L	6L	5½L	6L	6L	4½L	5½L	5L	4L	4L	4L	3L	3L	3½L	
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	7L	7L	6½L	6L	6½L	6½L	5½L	6L	6L	4½L	5L	5L	3½L	4L	4L	
+15	1st	X	X	X	X	X	X	X	X	X	6½L	6L	5½L	5½L	5½L	4½L	5L	5L	3½L	4L	4L	3L	3L	3½L	11	15	2½L	
	2nd	X	X	X	X	X	X	X	X	X	7L	6½L	5½L	6½L	6L	6L	5½L	5½L	4½L	5L	5L	3½L	4L	4L	3L	3L	3L	
	3rd	X	X	X	X	X	X	X	X	X	X	6½L	6L	7L	6½L	6L	6L	6½L	6L	5½L	5½L	4½L	5L	5L	3½L	4L	4L	
+10	1st	X	X	X	X	X	X	X	X	X	2½L	5½L	5L	5½L	5½L	5L	4½L	5L	5L	3½L	4L	4L	3L	3L	3L	11	15	2½L
	2nd	X	X	X	X	X	X	X	X	X	6½L	6L	5L	6L	6L	5½L	5L	5½L	5½L	4½L	5L	5L	3½L	4L	4L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6½L	5½L	6½L	6½L	6L	6L	6L	6L	5½L	5½L	5½L	4½L	5L	4½L	3½L	4L	4L
+5	1st	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5L	5L	5L	4½L	4½L	4½L	3½L	4L	4L	2½L	3L	3L	11	14	2L
	2nd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6L	5½L	5L	5L	5½L	5L	4½L	4½L	4½L	3½L	4L	3½L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	5L	6½L	6L	5½L	6L	6L	5½L	5L	5½L	5½L	4½L	4½L	4½L	3½L	3½L	4L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	5½L	5L	4L	5L	5L	4½L	4L	4½L	4½L	3½L	4L	4L	2½L	3L	3L	11	14	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	5L	4½L	5½L	5½L	5L	5L	5L	4L	4½L	4½L	4½L	3½L	4L	3½L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6½L	6L	5L	6L	5½L	5½L	5L	5½L	5L	4½L	4½L	4½L	3½L	3½L	3½L
-5	1st	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5L	4½L	4L	4L	4L	4L	3½L	3½L	3½L	2½L	3L	2½L	11	13	15
	2nd	X	X	X	X	X	X	X	X	X	6L	5L	4L	5½L	5L	4½L	5L	5L	4L	4L	4½L	4½L	3½L	3½L	3½L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	5L	4L	6L	5½L	5L	5½L	5½L	5L	5L	5L	4½L	4½L	4½L	3½L	3½L	2½L	2½L
-10	1st	X	X	X	X	X	X	X	X	X	5L	4L	3L	4½L	4L	3½L	4L	4L	4L	3½L	3½L	3½L	2½L	2½L	2½L	11	13	15
	2nd	X	X	X	X	X	X	X	X	X	6½L	4½L	3½L	5½L	5L	4L	4½L	4½L	4½L	4½L	4½L	4L	3½L	3½L	3½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	6L	5L	3½L	6L	5½L	4½L	5½L	5½L	5L	5L	5L	4½L	4½L	4½L	4L	3½L	3½L	3½L
-15	1st	X	X	14	X	X	X	X	X	X	5L	4L	3L	4½L	4L	3½L	4L	4L	3½L	3L	3½L	3L	2½L	2½L	3½L	11	13	14
	2nd	X	X	15	X	X	X	X	X	X	5½L	4L	3L	5L	4½L	4L	5½L	4½L	4L	4L	4L	4L	3½L	3½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3L	6L	5L	4L	5½L	5L	4½L	5L	5L	4½L	4½L	4L	3L	3½L	3½L	3½L
-20	1st	X	X	10	X	X	X	X	X	X	4½L	3½L	2½L	5½L	4L	3L	4½L	4L	3½L	3L	3L	3L	2½L	2½L	2½L	11	12	13
	2nd	X	X	11	X	X	X	X	X	X	5L	3½L	2½L	5L	4½L	3½L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	3L	2½L	2½L	2½L
	3rd	X	X	12	X	X	X	X	X	X	5½L	4L	3L	5½L	5L	4L	5L	5L	4½L	5L	5L	4½L	4L	4L	4L	3½L	3½L	3½L

VOLUME: 220,000 (YEN/DAY)

SPEED: 60 (MPH)

%TRUCK: 10%

%GRADE: 4 to 6

TABLE: 15-1

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	10	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	8	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	1	-																									
	2nd	3	-																									
	3rd	7	-																									

VOLUME: 2,500 (VEH./DAY) SPEED: 60 (M.P.H.) %TRUCK: 10% %GRADE: 7+

TABLE: 15-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+15	1st	X	X	X	X	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+10	1st	X	X	X	14	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+5	1st	14	X	X	12	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
GROUND LEVEL	1st	11	X	X	10	-																						
	2nd	14	X	X	15	-																						
	3rd	X	X	X	X	-																						
-5	1st	8	X	X	8	-																						
	2nd	12	X	X	14	-																						
	3rd	15	X	X	X	-																						
-10	1st	5	X	X	6	-																						
	2nd	9	X	X	12	-																						
	3rd	12	X	X	X	-																						
-15	1st	2	X	X	4	-																						
	2nd	6	X	X	10	-																						
	3rd	10	X	X	15	-																						
-20	1st	1	X	X	2	-																						
	2nd	3	X	X	8	-																						
	3rd	7	X	X	13	-																						

VOLUME: 3,800 (VEH./DAY) SPEED: 60 (M.P.H.) %TRUCK: 10% %GRADE: 7+

TABLE: 15-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 5,600 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+15	1st	X	X	X	X	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+10	1st	X	X	X	14	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
+5	1st	14	X	X	12	-																						
	2nd	X	X	X	X	-																						
	3rd	X	X	X	X	-																						
GROUND LEVEL	1st	11	12	X	10	-																						
	2nd	15	13	X	X	-																						
	3rd	X	15	X	X	-																						
-5	1st	8	8	X	8	-																						
	2nd	12	9	X	14	-																						
	3rd	X	11	X	X	-																						
-10	1st	5	3	X	6	-																						
	2nd	9	5	X	12	-																						
	3rd	13	7	X	X	-																						
-15	1st	2	X	X	4	-																						
	2nd	6	X	X	10	-																						
	3rd	10	3	X	15	-																						
-20	1st	1	X	X	2	-																						
	2nd	3	X	X	8	-																						
	3rd	7	X	X	14	-																						

TABLE: 15-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 8,400 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	-																			
	2nd	X	X	X	X	X	X	X	-																			
	3rd	X	X	X	X	X	X	X	-																			
+15	1st	X	X	X	X	X	X	14	-																			
	2nd	X	X	X	X	X	X	X	-																			
	3rd	X	X	X	X	X	X	X	-																			
+10	1st	X	X	X	14	X	X	12	-																			
	2nd	X	X	X	X	X	X	X	-																			
	3rd	X	X	X	X	X	X	X	-																			
+5	1st	15	X	X	12	15	X	11	-																			
	2nd	X	X	X	X	X	X	X	-																			
	3rd	X	X	X	X	X	X	X	-																			
GROUND LEVEL	1st	12	12	X	10	12	X	10	-																			
	2nd	15	13	X	X	15	X	X	-																			
	3rd	X	15	X	X	X	X	X	-																			
-5	1st	9	8	X	8	8	X	8	-																			
	2nd	13	9	X	14	11	X	15	-																			
	3rd	X	11	X	X	X	X	X	-																			
-10	1st	6	4	X	7	5	X	7	-																			
	2nd	10	5	X	12	8	X	14	-																			
	3rd	14	7	X	X	11	X	X	-																			
-15	1st	3	1	X	5	2	X	6	-																			
	2nd	7	1	X	10	5	X	13	-																			
	3rd	11	3	X	X	8	X	X	-																			
-20	1st	1	1	X	3	X	X	5	-																			
	2nd	4	1	X	8	X	X	11	-																			
	3rd	8	1	X	14	4	X	X	-																			

TABLE: 15-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	X	13	-																
	2nd	X	X	X	X	X	X	X	X	X	X	-																
	3rd	X	X	X	X	X	X	X	X	X	X	-																
+15	1st	X	X	X	X	X	X	14	X	X	12	-																
	2nd	X	X	X	X	X	X	X	X	X	X	-																
	3rd	X	X	X	X	X	X	X	X	X	X	-																
+10	1st	X	X	X	15	X	X	13	X	X	11	-																
	2nd	X	X	X	X	X	X	X	X	X	2L	-																
	3rd	X	X	X	X	X	X	X	X	X	3L	-																
+5	1st	X	X	X	13	15	X	11	14	X	10	-																
	2nd	X	X	X	X	X	X	X	X	X	2L	-																
	3rd	X	X	X	X	X	X	X	X	X	2½L	-																
GROUND LEVEL	1st	14	12	X	11	12	X	10	12	X	9	-																
	2nd	X	14	X	X	15	X	X	X	X	2L	-																
	3rd	X	15	X	X	X	X	X	X	X	2½L	-																
-5	1st	11	8	X	9	9	X	9	9	X	9	-																
	2nd	14	9	X	14	12	X	15	13	X	2L	-																
	3rd	X	11	X	X	14	X	X	X	X	2L	-																
-10	1st	8	4	X	7	5	X	7	6	X	8	-																
	2nd	12	1	X	13	5	X	14	11	X	15	-																
	3rd	15	7	X	X	11	X	X	15	X	2L	-																
-15	1st	5	1	X	5	2	X	6	4	X	7	-																
	2nd	9	1	X	11	5	X	13	8	X	14	-																
	3rd	13	3	X	X	8	X	X	12	X	2L	-																
-20	1st	2	1	X	3	1	X	5	X	X	6	-																
	2nd	6	1	X	9	1	X	12	5	X	13	-																
	3rd	10	1	X	14	4	X	X	10	X	2L	-																

VOLUME: 13,000 (VEH/DAY) SPEED: 60 (M.P.H.) %TRUCK: 10% %GRADE: 7+

TABLE: 15-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	X	13	3L	X	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½	X	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½	3½	X	3½	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	14	X	X	12	2½	X	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	X	2½	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½	3½	X	3½	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	13	X	X	11	15	X	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½	2½	X	2½	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	X	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	12	15	X	10	14	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2L	2L	X	2½	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	2½	2L	X	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	14	12	13	10	12	X	10	12	X	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	X	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	14	X	X	X	X	X	X	2L	2L	X	2½	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	14	8	8	12	9	9	9	9	X	9	10	X	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	X	12	10	X	14	X	2L	15	X	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	9	X	15	12	X	X	X	2L	2L	X	2½	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	11	4	3	10	6	4	8	7	X	8	8	X	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	15	6	4	15	8	6	14	11	X	15	13	X	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	7	5	X	11	8	X	15	X	2L	2L	X	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	8	1	X	8	2	X	6	4	X	7	6	X	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	12	2	X	14	5	2	13	8	X	15	11	X	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	X	X	8	4	X	12	X	2L	2L	X	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	5	1	X	6	1	X	5	1	X	6	4	X	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	9	1	X	12	2	X	12	6	X	14	9	X	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	13	1	X	X	5	X	X	10	X	2L	14	X	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME: 19,000 (VEH/DAY) SPEED: 60 (M.P.H.) %TRUCK: 10% %GRADE: 7+



TABLE: 15-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 28,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	-										
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	-										
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	-										
+15	1st	X	X	X	X	X	X	15	X	X	13	2½L	3L	11	2½L	2½L	10	14	-										
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	-										
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-										
+10	1st	X	X	X	X	X	X	14	X	X	12	15	2½L	11	15	2½L	10	13	-										
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-										
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3L	3½L	-										
+5	1st	X	X	X	X	X	X	13	15	X	11	14	X	10	13	15	10	12	-										
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-										
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	-										
GROUND LEVEL	1st	X	13	12	X	12	13	11	12	13	10	12	13	10	12	13	9	11	-										
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	-										
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	-										
-5	1st	X	9	8	14	9	5	10	10	9	9	10	10	1	10	11	9	10	-										
	2nd	X	10	8	X	12	10	X	14	12	2L	14	14	2L	2L	2L	2L	2L	-										
	3rd	X	12	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2½L	3L	2½L	-										
-10	1st	14	5	3	12	2	5	9	7	6	8	7	7	8	9	8	9	9	-										
	2nd	X	6	4	X	9	6	15	11	10	2L	11	11	X	15	13	2L	2L	-										
	3rd	X	8	5	X	12	8	X	X	11	2L	15	15	2½L	2L	2L	2½L	2½L	-										
-15	1st	11	1	1	10	2	1	7	4	3	8	4	4	8	7	6	8	8	-										
	2nd	15	2	1	15	5	2	14	9	5	15	8	8	2L	14	11	2L	15	-										
	3rd	X	4	1	X	8	4	X	13	8	2L	12	12	2L	2L	2L	2½L	2L	-										
-20	1st	8	1	1	8	1	1	6	2	X	7	X	X	7	6	4	8	7	-										
	2nd	13	1	1	14	2	1	13	6	2	14	5	5	15	12	9	2L	14	-										
	3rd	X	1	1	X	5	1	X	10	4	2L	9	9	2L	2L	14	2½L	2L	-										

TABLE: 15-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 43,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 10% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	15	3L	3½L	12	2½L	3L	11	2½L	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	3½L	-						
+15	1st	X	X	X	X	X	X	X	X	X	14	2½L	3L	12	2½L	2½L	11	15	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-						
+10	1st	X	X	X	X	X	X	X	X	X	13	15	2½L	11	15	2½L	11	14	2L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	-						
+5	1st	X	X	X	X	X	X	X	X	X	12	15	2L	11	14	2L	10	13	15	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-						
GROUND LEVEL	1st	X	X	13	X	13	13	X	13	13	11	13	13	10	12	13	10	12	13	9	11	-						
	2nd	X	X	14	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	14	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-						
-5	1st	X	12	8	X	10	10	15	10	6	10	11	11	9	11	11	9	11	11	9	11	-						
	2nd	X	14	8	X	13	11	X	15	13	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	X	10	X	X	12	X	X	15	2L	2L	2L	2½L	2½L	2½L	3L	2½L	2½L	3L	3L	-						
-10	1st	X	8	1	X	7	5	13	8	6	10	9	8	9	9	9	9	10	10	9	10	-						
	2nd	X	10	1	X	10	7	X	12	12	2L	14	11	2L	15	15	2L	2L	2L	2L	2L	-						
	3rd	X	12	5	X	13	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	3L	-						
-15	1st	15	4	1	14	4	4	12	5	3	9	7	5	8	8	6	8	8	8	8	9	-						
	2nd	X	2	1	X	7	3	X	9	6	2L	12	9	2L	14	11	2L	2L	14	2L	2L	-						
	3rd	X	3	1	X	10	11	X	14	8	2L	2L	12	2L	2L	2L	2½L	2½L	2L	3L	2½L	-						
-20	1st	13	1	1	12	1	1	11	3	1	8	5	2	8	6	4	8	7	6	8	8	-						
	2nd	X	2	1	X	3	1	X	7	2	15	10	6	2L	13	9	2L	14	12	2L	2L	-						
	3rd	X	3	1	X	6	1	X	11	5	2L	15	9	2L	2L	15	2½L	2L	2L	2½L	2½L	-						

TABLE: 15-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											VOLUME 64,000 (VEH./DAY)	SPEED 60 (MPH)	%TRUCK: 10%	%GRADE: 7+
		110			170			250			380			570			850			1300			1900			2900						
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd				
+20	1st	X	X	X	X	X	X	X	X	X	4L	3 1/2	3 1/2	3L	3L	3L	12	2 1/2	3L	11	15	2 1/2	10	13	2 1/2	9	12	-				
	2nd	X	X	X	X	X	X	X	X	X	4 1/2	4L	3 1/2	3 1/2	3 1/2	3 1/2	3L	3L	3 1/2	2 1/2	3L	3L	2 1/2	3L	3L	2 1/2	2 1/2	-				
	3rd	X	X	X	X	X	X	X	X	X	5L	4 1/2	4L	4L	4L	4L	3 1/2	4L	4L	3 1/2	3 1/2	4L	3 1/2	3 1/2	4L	3 1/2	2 1/2	-				
+15	1st	X	X	X	X	X	X	X	X	X	3 1/2	3L	3L	2 1/2	2 1/2	3L	11	2L	2 1/2	10	14	2 1/2	10	13	2L	9	12	-				
	2nd	X	X	X	X	X	X	X	X	X	4L	3 1/2	3 1/2	3 1/2	3 1/2	3L	2 1/2	3L	3L	2 1/2	3L	3L	2 1/2	2 1/2	3L	2 1/2	2 1/2	-				
	3rd	X	X	X	X	X	X	X	X	X	4 1/2	4L	3 1/2	4L	4L	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	-				
+10	1st	X	X	X	X	X	X	X	X	X	3L	3L	2 1/2	15	15	2 1/2	11	15	2 1/2	10	13	2L	9	12	15	9	12	-				
	2nd	X	X	X	X	X	X	X	X	X	3 1/2	3L	3L	3L	3L	3L	2 1/2	2 1/2	3L	2 1/2	2 1/2	3L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	-				
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	3L	4L	4L	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	-				
+5	1st	X	X	X	X	X	X	X	X	X	3L	2 1/2	2L	14	14	2L	11	14	2L	10	13	15	9	12	14	9	11	-				
	2nd	X	X	X	X	X	X	X	X	X	3 1/2	3L	2 1/2	3L	3L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	-				
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2 1/2	3 1/2	3 1/2	3 1/2	3L	3 1/2	3L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	-				
GROUND LEVEL	1st	X	X	13	X	X	X	X	X	X	15	2 1/2	2L	2L	14	14	14	10	12	14	10	12	14	9	11	13	9	11	-			
	2nd	X	X	14	X	X	X	X	X	X	3L	2 1/2	2L	3L	3L	3L	2L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	-				
	3rd	X	X	15	X	X	X	X	X	X	3 1/2	3L	2L	3 1/2	3 1/2	2 1/2	3L	3L	3L	3L	3L	3L	3L	3 1/2	3L	3 1/2	3 1/2	-				
-5	1st	X	X	9	X	X	6	X	X	11	2 1/2	2L	12	13	13	12	10	11	12	9	11	12	9	11	12	9	11	-				
	2nd	X	X	10	X	X	12	X	X	14	3L	2L	15	2 1/2	2 1/2	2L	2L	2L	2L	2L	2L	2 1/2	2 1/2	2L	2 1/2	2 1/2	2 1/2	-				
	3rd	X	X	11	X	X	14	X	X	X	3 1/2	2 1/2	2L	3L	3L	2 1/2	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-				
-10	1st	X	12	4	X	15	6	X	X	8	2L	2L	9	13	13	10	10	10	10	9	10	11	9	10	11	9	10	-				
	2nd	X	14	5	X	X	8	X	X	10	2 1/2	2L	13	2 1/2	2 1/2	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-				
	3rd	X	15	6	X	X	10	X	X	13	3L	2L	2L	3L	3L	2L	3L	2 1/2	2 1/2	3L	3L	2 1/2	3L	3L	3L	3L	3L	-				
-15	1st	X	8	1	X	11	2	X	13	4	2L	12	6	12	12	7	9	9	9	9	10	10	9	10	10	9	10	-				
	2nd	X	10	1	X	14	4	X	X	7	2L	2L	10	2L	2L	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-				
	3rd	X	11	1	X	X	5	X	X	10	2 1/2	2L	11	3L	3L	2L	2 1/2	2 1/2	2L	3L	2 1/2	2 1/2	3L	3L	3L	3L	3L	-				
-20	1st	X	4	1	X	8	1	X	10	1	15	10	3	12	12	5	8	8	1	9	9	8	9	9	9	9	10	-				
	2nd	X	6	1	X	11	1	X	15	3	2L	11	7	2L	2L	10	2L	15	13	2L	2L	15	2L	2L	2L	2L	2L	-				
	3rd	X	7	1	X	14	1	X	X	6	2 1/2	2L	11	2 1/2	2 1/2	15	2 1/2	2L	2L	3L	2 1/2	2 1/2	3L	3L	2 1/2	3L	3L	-				

VOLUME 64,000 (VEH/DAY) SPEED 60 (MPH) %TRUCK: 10% %GRADE: 7+

TABLE: 15-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5L	4 1/2	4 1/2	4L	4L	4L	15	2 1/2	3L	11	2L	2 1/2	10	14	2 1/2	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5 1/2	5L	4 1/2	4 1/2	4 1/2	4L	3 1/2	3 1/2	3 1/2	3L	3L	3 1/2	2 1/2	3L	3L	2 1/2	2 1/2	3L
	3rd	X	X	X	X	X	X	X	X	X	5 1/2	5 1/2	5L	5 1/2	5L	4 1/2	4L	4L	4L	3 1/2	4L	4L	3 1/2	3 1/2	4L	3 1/2	3 1/2	4L
+15	1st	X	X	X	X	X	X	X	X	X	4 1/2	4 1/2	4L	4L	4L	3 1/2	15	2 1/2	2 1/2	11	15	2 1/2	10	13	2L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	5L	4 1/2	4L	4 1/2	4L	3 1/2	4L	3 1/2	3L	2 1/2	3L	3L	2 1/2	3L	3L	2 1/2	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	5 1/2	5L	4 1/2	5L	5L	4L	4L	4L	4L	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2
+10	1st	X	X	X	X	X	X	X	X	X	4L	4L	3 1/2	3 1/2	3 1/2	3L	15	2 1/2	2 1/2	11	14	2L	10	13	2L	9	12	15
	2nd	X	X	X	X	X	X	X	X	X	4 1/2	4 1/2	3 1/2	4L	4L	3 1/2	3L	3L	3L	2 1/2	3L	3L	2 1/2	2 1/2	3L	2 1/2	2 1/2	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4 1/2	4L	5L	4 1/2	4L	4L	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2
+5	1st	X	X	X	X	X	X	X	X	X	4L	3 1/2	3L	3 1/2	3 1/2	3L	14	15	2L	10	13	2L	10	12	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4 1/2	4L	3L	4L	4L	3L	3L	3L	2L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3 1/2	4 1/2	4 1/2	3 1/2	4L	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3 1/2	3L	2 1/2	3L	3L	2 1/2	14	14	15	10	13	14	10	12	14	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	4L	3 1/2	3L	4L	3 1/2	3L	3L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
	3rd	X	X	X	X	X	X	X	X	X	4 1/2	4L	3L	4 1/2	4L	3L	3 1/2	3L	3L	3 1/2	3 1/2	3L	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2
-5	1st	X	X	15	X	X	X	X	X	X	3 1/2	3L	2L	3L	3L	2L	13	13	13	10	12	13	9	11	13	9	11	13
	2nd	X	X	15	X	X	X	X	X	X	4L	3L	2 1/2	3 1/2	3 1/2	2 1/2	3L	2 1/2	2L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
	3rd	X	X	X	X	X	X	X	X	X	4L	3 1/2	2 1/2	4 1/2	4L	3L	3 1/2	3L	2 1/2	3L	2 1/2	3L	3L	3L	3L	3L	3 1/2	3 1/2
-10	1st	X	X	10	X	X	14	X	X	X	3L	3L	2L	3L	2 1/2	2L	13	12	12	10	11	12	9	11	12	9	11	13
	2nd	X	X	7	X	X	X	X	X	X	3 1/2	3L	2L	2L	3 1/2	3L	2L	2 1/2	2L	2L	2 1/2	2L	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
	3rd	X	X	12	X	X	X	X	X	X	4L	3L	2L	4L	3 1/2	2 1/2	3 1/2	3L	2L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-15	1st	X	14	6	X	X	10	X	X	13	2 1/2	2L	15	2 1/2	2 1/2	14	13	11	10	9	10	10	9	10	11	9	10	11
	2nd	X	X	7	X	X	12	X	X	X	3L	2 1/2	2L	3 1/2	3L	2L	2 1/2	2L	2L	2L	2L	2L	2L	2L	2L	2L	2 1/2	2 1/2
	3rd	X	X	7	X	X	14	X	X	X	3 1/2	2 1/2	2L	4L	3 1/2	2L	3 1/2	2 1/2	2L	3L	3L	2 1/2	3L	3L	3L	3L	3L	3L
-20	1st	X	10	1	X	X	8	X	X	10	3L	2L	15	2 1/2	2L	12	12	10	8	9	10	9	9	10	10	9	10	11
	2nd	X	12	2	X	X	8	X	X	13	2 1/2	2L	2L	3L	2 1/2	2L	2 1/2	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L
	3rd	X	14	3	X	X	9	X	X	15	3 1/2	2 1/2	2L	3 1/2	3 1/2	2L	3L	2 1/2	2L	3L	2 1/2	2 1/2	2L	3L	3L	3L	3L	3L



TABLE: 15-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5½	5½	5L	4½	5L	5L	4L	4L	4L	3L	3L	3L	12	2L	2½	10	14	10
	2nd	X	X	X	X	X	X	X	X	X	6L	6L	5L	5½	5½	5L	4½	5L	5L	4L	4L	4L	3L	3L	3½	2½	3L	2½
	3rd	X	X	X	X	X	X	X	X	X	6½	6L	5½	6L	6L	5½	5½	5½	5½	4½	5L	4½	3½	4L	4L	3½	3½	3½
+15	1st	X	X	X	X	X	X	X	X	X	5½	5L	4½	4½	4½	4½	3½	4L	4L	3L	3L	3L	12	15	2½	10	13	10
	2nd	X	X	X	X	X	X	X	X	X	6L	5½	5L	5L	5L	5L	4½	4½	4½	3½	4L	3½	3L	3L	3L	2½	3L	2½
	3rd	X	X	X	X	X	X	X	X	X	6½	5½	5L	6L	5½	5½	5½	5½	5L	4½	4½	4L	3½	4L	4L	3½	3½	3½
+10	1st	X	X	X	X	X	X	X	X	X	5L	4½	4L	4½	4½	4L	3½	4L	3½	3L	3L	2½	11	15	2½	10	13	10
	2nd	X	X	X	X	X	X	X	X	X	5½	5L	4½	5L	5L	4½	4½	4½	4½	3½	4L	3½	2½	3L	3L	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	6L	5½	4½	5½	5½	5L	5L	5L	4½	4½	4L	3½	3½	4L	3½	3½	3½	3½
+5	1st	X	X	X	X	X	X	X	X	X	5L	4½	3½	4L	4L	4L	3½	3½	3½	2½	3L	2½	11	14	2L	10	13	10
	2nd	X	X	X	X	X	X	X	X	X	5½	4½	4L	5L	4½	4L	4L	4½	4L	3½	3½	3L	2½	3L	3L	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	5½	5L	4L	5½	5L	4½	5L	5L	4½	4½	4L	3½	3½	3L	3L	3L	3L	3L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	4½	4L	3½	4L	4L	3½	3½	3½	3L	2½	2½	2½	11	14	15	10	12	10
	2nd	X	X	X	X	X	X	X	X	X	5L	4½	3½	4½	4½	4L	4L	4L	3½	3½	3½	3L	2½	2½	3L	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	5½	4½	3½	5½	5L	4L	5L	5L	4½	4½	4L	3½	3½	3L	3L	3L	3L	3L
-5	1st	X	X	X	X	X	X	X	X	X	4L	3½	3L	4L	3½	3L	3L	3½	3L	2½	2½	2L	11	13	15	10	12	10
	2nd	X	X	X	X	X	X	X	X	X	4½	4L	3L	4½	4L	3½	4L	4L	3½	3½	3L	2½	2½	2½	2½	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½	5L	4½	4L	5L	4½	4L	4L	4L	3½	3½	3L	3L	3L	3L	3L
-10	1st	X	X	14	X	X	X	X	X	X	4L	3L	2½	3½	3L	3L	3L	2½	2½	2½	2L	11	12	14	10	12	10	10
	2nd	X	X	15	X	X	X	X	X	X	4½	3½	2½	4½	4L	3L	4L	3½	3L	2½	2½	2½	2½	2½	2½	2½	2½	2½
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3L	5L	3½	3½	4½	4½	4L	4L	4L	3½	3½	3L	3L	3L	3L	3L
-15	1st	X	X	9	X	X	15	X	X	X	3½	4L	4½	3½	3L	2½	3L	3L	2½	2½	2½	15	10	12	13	9	11	9
	2nd	X	X	10	X	X	X	X	X	X	3L	3L	3½	4L	3½	3L	3½	3½	3L	3L	2½	2½	2½	2½	2½	2½	2½	2½
	3rd	X	X	11	X	X	X	X	X	X	2L	2L	2½	4½	4L	3L	4½	4L	3½	4L	4L	3L	3½	3½	3L	3L	3L	3L
-20	1st	X	X	5	X	X	11	X	X	X	3½	2½	2L	3L	3L	2L	3L	2½	2L	15	2L	14	10	12	12	9	11	9
	2nd	X	X	6	X	X	13	X	X	X	4L	3L	2L	4L	3½	2½	3½	3½	2½	3L	3L	2L	2½	2½	2L	2½	2½	2½
	3rd	X	X	7	X	X	15	X	X	X	4L	3L	2L	4½	4L	3L	3½	4L	3L	4L	3L	3L	3L	3L	3L	3L	3L	3L

VOLUME: 140,000 (VEH./DAY) SPEED: 60 (M.P.H.) %TRUCK: 10% %GRADE: 7+

TABLE: 15-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	X	7L	6L	6½	6½	6½	5L	5½	6L	4L	5L	5L	3½	4L	4L	14	2½	2½
	2nd	X	X	X	X	X	X	X	X	X	X	X	6½	7L	7L	6½	6L	6½	6½	5L	5½	6L	4L	4½	5L	3½	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	X	X	6½	X	X	7L	7L	7L	7L	6L	6½	6½	5L	5½	5L	4L	4½	4L
+15	1st	X	X	X	X	X	X	X	X	X	X	6½	6L	6½	6½	6L	5L	5½	5½	4L	4½	5L	3L	3½	4L	14	2½	2½
	2nd	X	X	X	X	X	X	X	X	X	X	7L	6L	7L	7L	6½	6L	6L	6L	5L	5½	5L	4L	4½	5L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	X	X	6½	X	X	7L	6½	7L	6L	6L	6L	6L	5L	5½	5L	4L	4½	4L
+10	1st	X	X	X	X	X	X	X	X	X	7L	6L	5½	6L	6L	5½	5L	5½	5½	4L	4½	5L	3L	3½	4L	14	2½	2½
	2nd	X	X	X	X	X	X	X	X	X	X	6½	5½	6½	6½	6L	5½	6L	6L	5L	5½	5L	4L	4½	4L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	X	7L	6L	X	7L	6½	6½	6½	6½	5½	6L	6L	5L	5½	5L	4L	4½	4L
+5	1st	X	X	X	X	X	X	X	X	X	6½	6L	5L	6L	6L	5½	5L	5½	5½	4L	4½	4½	3L	3½	4L	14	2½	2½
	2nd	X	X	X	X	X	X	X	X	X	7L	6L	5L	6L	6½	6L	5½	6L	5L	5L	5L	4L	4½	4L	3L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	X	6½	5½	6L	7L	6L	6½	6½	6L	5L	5L	5L	4L	4½	4L	4L	4L	4L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	6½	5½	4½	5½	5½	5L	4½	5L	5L	4L	4½	4½	3L	3½	3L	14	2½	2½
	2nd	X	X	X	X	X	X	X	X	X	7L	6L	5L	6½	6L	5½	5½	5½	5½	4½	5L	5L	4L	4½	4L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	X	6L	5L	7L	6½	5½	6½	6½	6L	5½	6L	5½	5L	5L	5L	4L	4L	4L
-5	1st	X	X	X	X	X	X	X	X	X	6L	5½	4L	5½	5½	4½	4L	5L	4½	4L	4L	4L	3L	3½	3L	14	2½	2½
	2nd	X	X	X	X	X	X	X	X	X	6½	5½	4½	6L	6L	5L	5½	5½	5L	4½	5L	5L	4L	4L	4L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	4½	7L	6½	5½	6L	6L	5½	5½	5L	5L	5L	5L	5L	4L	4L	4L
-10	1st	X	X	X	X	X	X	X	X	X	6L	5L	3½	5½	5L	4½	4L	4½	3½	4L	4L	4L	3L	3½	3L	14	2L	2L
	2nd	X	X	X	X	X	X	X	X	X	6½	5L	4L	6L	5½	5L	5L	5½	5L	4½	5L	4½	4L	4L	4L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	5½	4L	6½	6L	5L	6L	6L	5½	5½	5L	5L	5L	5L	5L	4L	4L	4L
-15	1st	X	X	X	X	X	X	X	X	X	5½	4½	3½	5L	5L	4L	4½	4½	4L	3½	4L	4L	3L	3L	3L	13	2L	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	4½	3½	6L	5L	4½	5L	5L	4½	4½	4L	4L	4L	4L	4L	3L	3L	3L</

TABLE: 16-1

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
+15	1st	X	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
+10	1st	X	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
+5	1st	13	-	-																								
	2nd	X	-	-																								
	3rd	X	-	-																								
GROUND LEVEL	1st	10	-	-																								
	2nd	11	-	-																								
	3rd	X	-	-																								
-5	1st	8	-	-																								
	2nd	11	-	-																								
	3rd	15	-	-																								
-10	1st	5	-	-																								
	2nd	8	-	-																								
	3rd	12	-	-																								
-15	1st	2	-	-																								
	2nd	6	-	-																								
	3rd	9	-	-																								
-20	1st	1	-	-																								
	2nd	3	-	-																								
	3rd	7	-	-																								

VOLUME: 2,500 (VEH./DAY) SPEED: 60 (M.P.H.) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+15	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+10	1st	X	-	-	14	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+5	1st	14	-	-	12	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
GROUND LEVEL	1st	11	-	-	10	-	-																					
	2nd	14	-	-	15	-	-																					
	3rd	X	-	-	X	-	-																					
-5	1st	8	-	-	8	-	-																					
	2nd	12	-	-	14	-	-																					
	3rd	15	-	-	X	-	-																					
-10	1st	5	-	-	6	-	-																					
	2nd	9	-	-	12	-	-																					
	3rd	12	-	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	10	-	-																					
	3rd	10	-	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	7	-	-	13	-	-																					

VOLUME: 3,800 (VEH./DAY) SPEED: 60 (M.P.H.) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	-	-	X	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
+15	1st	X	-	-	X	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
+10	1st	X	-	-	14	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
+5	1st	14	-	-	12	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
GROUND LEVEL	1st	11	-	-	10	-																							
	2nd	15	-	-	X	-																							
	3rd	X	-	-	X	-																							
-5	1st	8	-	-	8	-																							
	2nd	12	-	-	14	-																							
	3rd	15	-	-	X	-																							
-10	1st	5	-	-	6	-																							
	2nd	9	-	-	12	-																							
	3rd	13	-	-	X	-																							
-15	1st	2	-	-	4	-																							
	2nd	6	-	-	10	-																							
	3rd	10	-	-	15	-																							
-20	1st	1	-	-	2	-																							
	2nd	3	-	-	8	-																							
	3rd	7	-	-	13	-																							

VOLUME: 5,600 (VEH./DAY)

SPEED 60 (M.P.H.)

% TRUCK: 20%

% GRADE: 0 to

VOLUME: 5,600 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-	-	15	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+15	1st	X	X	-	X	-	-	14	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+10	1st	X	X	-	14	-	-	12	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
+5	1st	14	X	-	12	-	-	11	-	-																		
	2nd	X	X	-	X	-	-	X	-	-																		
	3rd	X	X	-	X	-	-	X	-	-																		
GROUND LEVEL	1st	11	12	-	10	-	-	10	-	-																		
	2nd	15	13	-	X	-	-	X	-	-																		
	3rd	X	15	-	X	-	-	X	-	-																		
-5	1st	8	8	-	8	-	-	8	-	-																		
	2nd	12	9	-	14	-	-	15	-	-																		
	3rd	X	11	-	X	-	-	X	-	-																		
-10	1st	5	4	-	6	-	-	7	-	-																		
	2nd	9	5	-	12	-	-	14	-	-																		
	3rd	13	7	-	X	-	-	X	-	-																		
-15	1st	2	-	-	4	-	-	6	-	-																		
	2nd	6	-	-	10	-	-	12	-	-																		
	3rd	10	3	-	X	-	-	X	-	-																		
-20	1st	1	-	-	3	-	-	5	-	-																		
	2nd	3	-	-	8	-	-	11	-	-																		
	3rd	7	-	-	14	-	-	X	-	-																		

VOLUME: 8,400 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	-	-	13	-																
	2nd	X	X	-	X	X	-	X	-	-	3L	-																
	3rd	X	X	-	X	X	-	X	-	-	3½L	-																
+15	1st	X	X	-	X	X	-	14	-	-	12	-																
	2nd	X	X	-	X	X	-	X	-	-	3L	-																
	3rd	X	X	-	X	X	-	X	-	-	3½L	-																
+10	1st	X	X	-	14	X	-	12	-	-	11	-																
	2nd	X	X	-	X	X	-	X	-	-	2½L	-																
	3rd	X	X	-	X	X	-	X	-	-	3L	-																
+5	1st	X	X	-	13	15	-	11	-	-	10	-																
	2nd	X	X	-	X	X	-	X	-	-	2L	-																
	3rd	X	X	-	X	X	-	X	-	-	2½L	-																
GROUND LEVEL	1st	14	12	-	11	12	-	10	-	-	9	-																
	2nd	X	14	-	X	15	-	X	-	-	2L	-																
	3rd	X	15	-	X	X	-	X	-	-	2½L	-																
-5	1st	11	8	-	9	8	-	9	-	-	9	-																
	2nd	14	9	-	14	11	-	15	-	-	2L	-																
	3rd	X	11	-	X	14	-	X	-	-	2L	-																
-10	1st	8	4	-	7	5	-	7	-	-	8	-																
	2nd	12	5	-	12	8	-	14	-	-	15	-																
	3rd	15	7	-	X	11	-	X	-	-	2L	-																
-15	1st	5	1	-	5	2	-	6	-	-	7	-																
	2nd	9	1	-	10	5	-	13	-	-	14	-																
	3rd	13	3	-	X	8	-	X	-	-	2L	-																
-20	1st	2	1	-	3	-	-	5	-	-	6	-																
	2nd	6	1	-	8	-	-	11	-	-	13	-																
	3rd	10	1	-	14	4	-	X	-	-	2L	-																

VOLUME: 13,000 (VEH./DAY)

SPEED: 60 (MPH)

%TRUCK: 20%

%GRADE: 0 to 3

VOLUME: 13,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	14	X	-	12	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	15	X	X	13	X	-	11	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	13	15	X	11	14	-	10	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	12	12	12	10	12	-	10	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	14	X	X	X	X	X	-	2½L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	14	8	8	10	9	8	9	9	-	9	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	15	12	10	X	13	-	2L	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	9	X	15	12	X	X	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	11	4	3	12	7	5	8	7	-	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	15	6	4	13	9	6	14	11	-	15	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	7	5	X	11	8	X	15	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	8	1	-	6	2	-	6	4	-	7	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	15	12	-	11	5	-	13	8	-	15	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	-	X	8	-	X	12	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	5	1	-	4	1	-	5	1	-	6	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	9	1	-	9	2	-	12	5	-	14	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	13	1	-	15	5	-	10	10	-	2L	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME: 19,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 0 to 3



TABLE: 16-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																													
		110			170			250			380			570			850			1300			1900			2900					
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd			
+20	1st	X	X	X	X	X	X	X	X	X	13	3L	3L	12	2½L	-	11	-													
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	-	2½L	-													
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3½L	3½L	-	3½L	-													
+15	1st	X	X	X	X	X	X	15	X	X	12	2½L	3L	11	2½L	-	10	-													
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	-	2½L	-													
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	-	3½L	-													
+10	1st	X	X	X	X	X	X	15	X	X	12	15	2½L	11	15	-	10	-													
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-													
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	-	3L	-													
+5	1st	X	X	X	X	X	X	15	15	X	11	14	2L	10	13	-	10	-													
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-													
	3rd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	3L	3L	-	3L	-													
GROUND LEVEL	1st	X	14	12	X	12	13	11	12	13	10	12	13	9	11	-	9	-													
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	-	2L	-													
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	2½L	2½L	-	3L	-													
-5	1st	15	8	8	14	9	9	9	9	9	9	10	10	9	10	-	9	-													
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	2L	-	2L	-													
	3rd	X	12	9	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	-													
-10	1st	12	4	3	12	6	5	8	7	6	8	7	6	8	9	-	8	-													
	2nd	X	6	4	X	9	6	15	11	10	2L	13	11	2L	15	-	2L	-													
	3rd	X	8	5	X	12	8	X	15	11	2L	2L	15	2L	2L	-	2½L	-													
-15	1st	10	1	1	10	2	1	7	4	2	7	6	4	8	7	-	8	-													
	2nd	14	2	1	15	5	2	13	8	5	15	11	8	2L	13	-	2L	-													
	3rd	X	3	1	X	8	4	X	13	8	2L	2L	12	2L	2L	-	2½L	-													
-20	1st	7	1	1	8	1	1	5	2	1	6	4	1	7	6	-	8	-													
	2nd	11	1	1	14	2	1	12	6	2	14	10	6	15	12	-	2L	-													
	3rd	15	1	1	X	5	1	X	X	4	2L	15	9	2L	2L	-	2½L	-													

VOLUME: 28,000 (VEH./DAY) SPEED: 60 (M.P.H.) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																													
		110			170			250			380			570			850			1300			1900			2900					
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW					
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd			
+20	1st	X	X	X	X	X	X	X	X	X	15	3L	3½L	12	2½L	3L	11	2½L	2½L	10	14	-									
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	-									
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	3½L	-									
+15	1st	X	X	X	X	X	X	X	X	X	14	2½L	3L	12	2½L	2½L	11	15	2½L	10	14	-									
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	-									
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-									
+10	1st	X	X	X	X	X	X	X	X	X	13	15	2½L	11	15	2½L	10	14	2L	10	13	-									
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-									
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	-									
+5	1st	X	X	X	X	X	X	X	X	X	12	15	2L	11	14	2L	10	13	15	9	12	-									
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-									
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-									
GROUND LEVEL	1st	X	14	12	X	14	13	X	13	13	11	13	13	10	12	13	10	12	13	9	11	-									
	2nd	X	X	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	-									
	3rd	X	X	14	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-									
-5	1st	X	10	8	X	9	10	15	10	10	10	11	11	9	11	11	9	11	11	9	11	-									
	2nd	X	12	8	X	13	11	X	15	13	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-									
	3rd	X	13	10	X	X	12	X	X	15	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	3L	3L	-								
-10	1st	X	6	3	X	7	5	13	8	6	10	9	9	9	9	9	9	10	10	9	10	-									
	2nd	X	4	8	X	10	6	X	12	10	2L	14	11	2L	15	14	2L	2L	2L	2L	2L	-									
	3rd	X	9	5	X	13	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	3L	-									
-15	1st	13	2	1	14	4	1	12	5	3	9	7	5	8	8	6	8	8	8	8	9	-									
	2nd	X	3	1	X	7	3	X	9	6	2L	12	9	2L	14	11	2L	2L	14	2L	2L	-									
	3rd	X	5	1	X	10	4	X	14	8	2L	2L	12	2L	2L	2L	2½L	2½L	2L	3L	2½L	-									
-20	1st	10	1	1	12	1	1	11	3	1	8	5	2	8	6	4	8	7	6	8	8	-									
	2nd	14	1	1	X	3	1	X	7	2	15	10	6	2L	13	9	2L	14	12	2L	2L	-									
	3rd	X	1	1	X	6	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	2½L	-									

VOLUME: 43,000 (YR/DAY)

SPEED: 60 (MPH)

% FLOCK: 20%

% BARNED: 0 TO



TABLE: 16-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3½L	3L	3½L	13	2½L	3L	11	2½L	3L	10	15	2½L	10	13	2L	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	2½L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	4L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	4L	-	-	-
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	13	2½L	3L	11	15	2½L	10	14	2½L	10	13	2L	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-
+10	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	12	2L	2½L	11	14	2½L	10	13	2L	9	12	15	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-
+5	1st	X	X	X	X	X	X	X	X	X	2½L	2L	2L	12	14	2L	10	13	15	10	12	15	9	12	14	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	-	-	-
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	15	2½L	2L	15	11	13	13	10	12	14	9	12	31	9	11	13	-	-	-
	2nd	X	X	14	X	X	15	X	X	X	3L	2L	2L	2½L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-	-	-
	3rd	X	X	15	X	X	X	X	X	X	3½L	2½L	2½L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-	-	-
-5	1st	X	14	8	X	X	10	X	15	10	15	12	11	11	11	12	10	11	12	9	11	12	9	11	12	-	-	-
	2nd	X	X	14	X	X	11	X	X	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	X	10	X	X	13	X	X	X	3L	2L	2L	2½L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	-	-	-
-10	1st	X	10	4	X	12	5	X	12	7	14	10	8	10	10	7	9	10	10	9	10	11	9	10	11	-	-	-
	2nd	X	12	5	X	15	7	X	X	10	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	X	6	X	X	9	X	X	12	2½L	2L	2L	2½L	2L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	-	-	-
-15	1st	X	5	1	X	9	1	X	10	3	13	8	5	9	8	7	9	9	9	9	9	9	9	10	10	-	-	-
	2nd	X	8	1	X	12	3	X	14	6	2L	13	9	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	-	-	-
	3rd	X	10	1	X	15	5	X	X	9	2½L	2L	13	2½L	2L	2L	3L	2½L	2L	3L	2½L	2½L	3L	3L	3L	-	-	-
-20	1st	15	2	1	X	6	1	15	7	1	13	6	2	9	7	5	9	9	8	8	9	8	8	9	9	-	-	-
	2nd	X	4	1	X	9	1	X	11	3	2L	11	6	2L	13	10	2L	15	12	2L	2L	15	2L	2L	2L	-	-	-
	3rd	X	3	1	X	12	1	X	X	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	-	-	-

VOLUME: 64,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	3½L	3½L	3½L	15	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2½L
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	4½L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	
+15	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3½L	3½L	3½L	15	2½L	2½L	11	15	2½L	10	13	2½L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	3½L	4L	4L	3½L	3½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+10	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	2½L	15	2½L	2½L	11	14	2L	10	13	2L	9	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	2½L	14	15	2L	10	13	2L	10	12	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	2½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	4½L	3L	4½L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2L	14	14	15	10	13	14	9	11	14	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	13	X	X	15	X	X	X	3L	2½L	2L	2½L	2½L	14	13	13	13	10	12	13	9	11	13	9	11	13
	2nd	X	X	14	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	14	X	X	X	X	X	X	4L	3L	2L	4L	3½L	2L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L
-10	1st	X	X	8	X	X	11	X	X	X	2½L	2L	13	3L	2L	12	13	12	12	10	11	12	9	11	12	9	11	12
	2nd	X	X	9	X	X	13	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	10	X	X	15	X	X	X	3½L	2½L	2L	4L	3L	2L	3½L	3L	2L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-15	1st	X	12	3	X	X	8	X	X	X	2½L	2L	10	2½L	2L	9	13	11	10	9	10	10	9	10	11	9	10	11
	2nd	X	14	4	X	X	9	X	X	X	3L	2L	14	3L	2½L	14	2½L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	2½L
	3rd	X	15	5	X	X	11	X	X	X	3½L	2½L	2L	3½L	3L	2L	3½L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L
-20	1st	X	8	1	X	13	3	X	X	5	2L	2L	7	2L	15	7	12	10	8	9	10	9	9	10	10	9	10	11
	2nd	X	10	1	X	X	5	X	X	9	2½L	2L	11	3½L	2L	12	2½L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	2L
	3rd	X	11	1	X	X	7	X	X	12	3L	2L	15	3½L	2½L	2L	3L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L

TABLE: 16-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	5L	5L	4½L	4½L	4½L	4½L	3½L	3½L	3½L	15	2½L	3L	11	15	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	5L	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	2½L	3L	3L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5½L	5½L	5L	5L	5L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	4L
+15	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4L	4½L	4L	3½L	3½L	3½L	15	2½L	2½L	11	14	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4L	4L	4L	3½L	3L	3½L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	4½L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	4L
+10	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3L	3½L	3L	14	2½L	2½L	11	14	2L	10	13	15
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	4L	3½L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5½L	5L	4½L	4L	4L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	3½L	3½L	3L	3L	3L	14	2L	2L	10	13	2L	10	12	15
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	4L	3½L	3L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	5L	4L	4½L	4½L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	3L	3L	2½L	14	15	2L	10	13	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	4L	3½L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	5L	4½L	4L	4½L	4½L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	3L	3L	2½L	14	15	15	10	12	14	9	12	13
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3½L	4½L	4L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
-10	1st	X	X	12	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2½L	2½L	2½L	2½L	13	14	13	10	12	13	9	11	13
	2nd	X	X	13	X	X	X	X	X	X	4L	3L	2½L	4L	3½L	2½L	3½L	3½L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3L	4½L	4L	3L	3½L	3½L	3L	3½L	3L	3½L	3½L	3½L	3½L
-15	1st	X	X	7	X	X	13	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2½L	2L	13	13	12	10	11	12	9	11	12
	2nd	X	X	8	X	X	14	X	X	X	3½L	2½L	2L	3½L	3L	2½L	3½L	3L	2½L	3L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	9	X	X	X	X	X	X	4L	3L	2L	4½L	3½L	2½L	4L	3½L	3L	3½L	3L	3L	3L	3L	3L	3L	3L	3L
-20	1st	X	13	3	X	X	9	X	X	15	3L	2L	2L	3L	2½L	2L	2½L	2L	14	13	12	11	9	11	11	9	10	11
	2nd	X	15	14	X	X	10	X	X	X	3½L	2½L	2L	3½L	3L	2L	3L	3L	2L	2½L	2½L	2L	2½L	2L	2L	2½L	2½L	2½L
	3rd	X	X	5	X	X	12	X	X	X	3½L	2½L	2L	4L	3½L	2½L	4L	3½L	2½L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L

VOLUME: 140,000 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 0 to 3

TABLE: 16-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	7L	6½L	6L	6L	6L	5L	4½L	5L	5½L	3½L	4½L	4½L	3L	3½L	3½L	11	15	2½L
	2nd	X	X	X	X	X	X	X	X	X	7½L	6L	6½L	6½L	5L	5½L	6L	6L	4½L	5L	5L	4L	4L	4L	3L	3L	3½L	
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	7L	7L	5½L	6L	6½L	6½L	5½L	6L	6L	4½L	5L	5L	3½L	4L	4L	
+15	1st	X	X	X	X	X	X	X	X	X	6½L	6L	5½L	5½L	5½L	5½L	4½L	5L	5L	3½L	4L	4½L	3L	3L	3½L	11	15	2½L
	2nd	X	X	X	X	X	X	X	X	X	7L	6½L	5½L	6½L	6L	5L	5½L	5½L	4½L	5L	5L	3½L	4L	4½L	3L	3L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6½L	6L	7L	6½L	6L	6L	6½L	6L	5½L	5½L	5½L	4½L	5L	5L	3½L	4L	4L	
+10	1st	X	X	X	X	X	X	X	X	X	6½L	5½L	5L	5½L	5L	4½L	5L	5L	3½L	4L	4L	3L	3L	3L	11	15	2½L	
	2nd	X	X	X	X	X	X	X	X	X	6½L	6L	5L	6L	6L	5½L	5L	5½L	5½L	4½L	5L	5L	3½L	4L	4L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6½L	5½L	6½L	6½L	6L	6L	6L	5½L	5½L	5½L	4½L	5L	5½L	3½L	4L	4L	
+5	1st	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5L	5L	5L	4½L	4½L	4½L	3½L	4L	4L	2½L	3L	3L	11	14	2L
	2nd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6L	5½L	5L	5L	5½L	5L	4½L	4½L	4½L	3½L	4L	3½L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	5L	6½L	6L	5½L	6L	6L	5½L	5L	5½L	5½L	4½L	4½L	4½L	3½L	3½L	4L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	5½L	5L	5L	5L	5L	4½L	4L	4½L	4½L	3½L	4L	4L	2½L	3L	3L	11	14	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	5L	4½L	5½L	5½L	5L	5L	5L	4½L	4½L	4½L	3½L	4L	3½L	2½L	3L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6½L	6L	5L	6L	5½L	5½L	5L	5½L	5L	4½L	4½L	4½L	3½L	3½L	3½L
-5	1st	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5L	4½L	4L	4L	4L	4L	3½L	3½L	3½L	2½L	3L	2½L	11	13	15
	2nd	X	X	X	X	X	X	X	X	X	6L	5L	4L	5½L	5L	4½L	5L	5L	4½L	4L	4½L	4½L	3½L	3½L	3½L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	5L	4L	6L	5½L	5L	5½L	5½L	5L	5L	5L	4½L	4½L	4L	3½L	3½L	3½L	
-10	1st	X	X	X	X	X	X	X	X	X	5L	4L	3L	4½L	4½L	3½L	4L	4L	4L	3½L	3½L	2½L	2½L	2½L	11	13	15	
	2nd	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5½L	5L	4L	4½L	4½L	4L	4L	4L	3½L	3½L	3½L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	6L	5L	3½L	6L	5½L	4½L	5½L	5½L	5L	5L	5L	4½L	4½L	4L	3½L	3½L	3½L	
-15	1st	X	X	14	X	X	X	X	X	X	5L	4L	3L	4½L	4L	3½L	4L	4L	3½L	3L	3½L	3½L	2½L	2½L	2½L	11	13	14
	2nd	X	X	15	X	X	X	X	X	X	5½L	4L	3L	5L	4½L	4L	4½L	4½L	4L	4L	4L	3½L	3½L	3L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3L	6L	5L	4L	5½L	5L	4½L	5L	5L	4½L	4½L	4L	3½L	3½L	3½L	
-20	1st	X	X	X	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3L	3½L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	11	12	13
	2nd	X	X	11	X	X	X	X	X	X	5L	3½L	2½L	5L	4½L	3½L	4½L	4L	4L	4L	4L	3½L	3½L	3L	2½L	2½L	2½L	
	3rd	X	X	12	X	X	X	X	X	X	5½L	4L	3L	5½L	5L	4L	5L	5L	4½L	5L	5L	4½L	4L	4L	3½L	3½L	3½L	

VOLUME 220,000 (VEH./DAY)

SPEED 60 (M.P.H.)

%TRUCK: 20%

%GRADE: 0 to 3

TABLE: 17-1

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+15	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+10	1st	X	-																									
	2nd	X	-																									
	3rd	X	-																									
+5	1st	13	-																									
	2nd	X	-																									
	3rd	X	-																									
GROUND LEVEL	1st	11	-																									
	2nd	14	-																									
	3rd	X	-																									
-5	1st	8	-																									
	2nd	11	-																									
	3rd	15	-																									
-10	1st	5	-																									
	2nd	9	-																									
	3rd	12	-																									
-15	1st	2	-																									
	2nd	6	-																									
	3rd	9	-																									
-20	1st	1	-																									
	2nd	3	-																									
	3rd	7	-																									

VOLUME: 2,500 (VEH/DAY)

SPEED: 50 (MPH)

%TRUCK: 20%

%GRADE: 4 to

VOLUME: 2,500 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 17-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	-	-	X	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
+15	1st	X	-	-	X	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
+10	1st	X	-	-	14	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
+5	1st	14	-	-	12	-																							
	2nd	X	-	-	X	-																							
	3rd	X	-	-	X	-																							
GROUND LEVEL	1st	11	-	-	10	-																							
	2nd	15	-	-	X	-																							
	3rd	X	-	-	X	-																							
-5	1st	8	-	-	8	-																							
	2nd	12	-	-	14	-																							
	3rd	15	-	-	X	-																							
-10	1st	5	-	-	6	-																							
	2nd	9	-	-	12	-																							
	3rd	13	-	-	X	-																							
-15	1st	2	-	-	4	-																							
	2nd	6	-	-	10	-																							
	3rd	10	-	-	15	-																							
-20	1st	1	-	-	2	-																							
	2nd	3	-	-	8	-																							
	3rd	7	-	-	13	-																							

VOLUME: 3,800 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 17-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st.	X	X	-	X	-	-	15	-																			
	2nd.	X	X	-	X	-	-	X	-																			
	3rd.	X	X	-	X	-	-	X	-																			
+15	1st.	X	X	-	X	-	-	14	-																			
	2nd.	X	X	-	X	-	-	X	-																			
	3rd.	X	X	-	X	-	-	X	-																			
+10	1st.	X	X	-	14	-	-	12	-																			
	2nd.	X	X	-	X	-	-	X	-																			
	3rd.	X	X	-	X	-	-	X	-																			
+5	1st.	14	X	-	12	-	-	11	-																			
	2nd.	X	X	-	X	-	-	X	-																			
	3rd.	X	X	-	X	-	-	X	-																			
GROUND LEVEL	1st.	11	12	-	10	-	-	10	-																			
	2nd.	15	13	-	X	-	-	X	-																			
	3rd.	X	15	-	X	-	-	X	-																			
-5	1st.	8	8	-	8	-	-	8	-																			
	2nd.	12	9	-	14	-	-	15	-																			
	3rd.	X	11	-	X	-	-	X	-																			
-10	1st.	5	3	-	6	-	-	7	-																			
	2nd.	9	5	-	12	-	-	14	-																			
	3rd.	13	7	-	X	-	-	X	-																			
-15	1st.	2	-	-	4	-	-	6	-																			
	2nd.	6	-	-	10	-	-	12	-																			
	3rd.	10	3	-	X	-	-	X	-																			
-20	1st.	1	-	-	3	-	-	5	-																			
	2nd.	3	-	-	8	-	-	11	-																			
	3rd.	7	-	-	14	-	-	X	-																			

VOLUME: 5,600 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 17-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											
		110			170			250			380			570			850			1300			1900			2900			
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	-	X	X	-	15	-																				
	2nd	X	X	-	X	X	-	X	-																				
	3rd	X	X	-	X	X	-	X	-																				
+15	1st	X	X	-	X	X	-	14	-																				
	2nd	X	X	-	X	X	-	X	-																				
	3rd	X	X	-	X	X	-	X	-																				
+10	1st	X	X	-	14	X	-	12	-																				
	2nd	X	X	-	X	X	-	X	-																				
	3rd	X	X	-	X	X	-	X	-																				
+5	1st	15	X	-	12	15	-	11	-																				
	2nd	X	X	-	X	X	-	X	-																				
	3rd	X	X	-	X	X	-	X	-																				
GROUND LEVEL	1st	12	12	-	10	12	-	10	-																				
	2nd	15	13	-	X	15	-	X	-																				
	3rd	X	15	-	X	X	-	X	-																				
-5	1st	9	8	-	8	8	-	9	-																				
	2nd	13	9	-	14	11	-	15	-																				
	3rd	X	11	-	X	14	-	X	-																				
-10	1st	6	4	-	7	5	-	7	-																				
	2nd	10	5	-	12	8	-	14	-																				
	3rd	14	7	-	X	11	-	X	-																				
-15	1st	3	1	-	5	2	-	6	-																				
	2nd	7	1	-	10	5	-	13	-																				
	3rd	11	3	-	X	8	-	X	-																				
-20	1st	1	1	-	3	1	-	5	-																				
	2nd	4	1	-	8	1	-	11	-																				
	3rd	8	1	-	14	4	-	X	-																				

VOLUME: 8,400 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 4 to 6



TABLE: 17-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	-	15	X	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	-	X	X	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	-	14	X	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	-	X	X	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	15	X	-	13	X	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	-	X	X	-	1½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	13	15	-	11	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	15	12	12	11	12	-	10	12	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	14	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	15	8	8	9	9	-	9	9	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	14	12	-	X	13	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	9	X	14	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	9	4	3	7	5	-	8	7	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	13	5	4	13	-	-	14	11	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	7	5	X	11	-	X	15	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	7	1	-	5	2	-	6	4	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	10	1	-	11	5	-	13	8	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	14	3	5	X	8	-	X	12	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	4	1	-	3	1	-	5	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	8	1	-	9	1	-	12	5	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	12	1	-	14	4	-	X	10	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME: 13,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 17-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	3L	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	14	X	-	12	2½L	-	11	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	3L	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	13	X	-	11	15	-	11	15	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	3L	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	12	15	-	11	14	-	10	13	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	3L	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	X	12	13	10	12	-	10	12	-	9	11	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	X	X	X	-	2L	2L	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	-	2½L	2L	-	2½L	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	15	8	3	12	9	9	9	9	-	9	10	-	9	10	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	8	X	12	10	X	14	-	2L	15	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	12	9	X	15	12	X	X	-	2L	2L	-	2½L	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	12	4	3	10	6	4	8	7	-	8	8	-	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	6	4	15	8	6	14	11	-	15	13	-	2L	15	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	11	8	X	15	-	2L	2L	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	10	1	1	8	2	-	6	4	-	7	6	-	8	7	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	14	2	1	14	5	2	13	8	-	15	11	-	2L	13	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	1	X	8	4	X	12	-	2L	2L	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	7	1	1	6	1	-	5	1	-	6	4	-	7	5	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	11	1	1	12	2	-	12	6	-	14	9	-	15	12	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	15	1	1	X	5	-	X	10	-	2L	14	-	2L	2L	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME: 19,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 4 to 6



TABLE: 17-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	14	3L	3½L	12	2½L	3L	11	2½L	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	-							
+15	1st	X	X	X	X	X	X	X	X	X	13	2½L	3L	11	2½L	2½L	11	15	2½L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-							
+10	1st	X	X	X	X	X	X	X	X	X	12	15	2½L	11	15	2½L	10	14	2L	10	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	-							
+5	1st	X	X	X	X	X	X	15	15	X	11	14	2L	10	13	15	10	12	15	9	-							
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-							
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	-							
GROUND LEVEL	1st	X	14	12	X	13	13	13	14	13	10	12	13	10	12	13	9	11	13	9	-							
	2nd	X	X	13	X	X	15	X	X	X	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-							
	3rd	X	X	14	X	X	12	X	X	X	2½L	2L	2L	3L	2½L	2½L	3L	3L	3L	3L	-							
-5	1st	X	10	8	X	10	9	13	10	10	10	10	10	9	10	11	9	10	11	9	-							
	2nd	X	12	8	X	12	11	X	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	-							
	3rd	X	13	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	2½L	3L	2½L	2½L	3L	-							
-10	1st	X	6	3	14	6	5	11	7	6	9	8	7	9	9	9	9	9	9	9	-							
	2nd	X	8	4	X	9	6	X	12	10	2L	14	11	2L	15	13	2L	2L	2L	2L	-							
	3rd	X	9	5	X	12	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	-							
-15	1st	13	2	1	12	3	1	10	5	3	8	6	5	8	7	6	8	8	8	8	-							
	2nd	X	3	1	X	6	2	X	9	5	15	12	8	2L	14	11	2L	15	13	2L	-							
	3rd	X	5	1	X	9	4	X	13	8	2L	2L	12	2L	2L	2L	2L	2L	2L	3L	-							
-20	1st	10	1	1	10	1	1	9	2	-	7	4	2	7	6	4	8	7	6	8	-							
	2nd	14	1	1	15	2	1	15	6	2	15	10	5	15	12	9	2L	14	12	2L	-							
	3rd	X	1	1	X	5	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	-							

VOLUME 28,000 (VEH./DAY)

SPEED: 60 (M.P.H.)

%TRUCK: 20%

%GRADE: 4 to

VOLUME: 28,000 (VEH./DAY) SPEED: 60 (M.P.H) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 17-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3L	3L	3½L	13	2½L	3L	11	2½L	2½L	10	14	2½L	10	3	-			
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L	3L	3½L	4L	3½L	3½L	-			
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	12	2½L	2½L	11	15	2½L	10	14	2½L	10	13	-			
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+10	1st	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	11	15	2½L	10	14	2L	10	13	2L	9	12	-			
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-			
+5	1st	X	X	X	X	X	X	X	X	X	15	15	2L	11	14	2L	10	13	15	10	12	14	9	12	-			
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-			
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-			
GROUND LEVEL	1st	X	X	13	X	X	13	X	14	14	14	13	14	10	12	14	10	12	13	9	11	13	9	11	-			
	2nd	X	X	14	X	X	15	X	X	X	2½L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-			
	3rd	X	X	15	X	X	X	X	X	X	3L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-			
-5	1st	X	14	8	X	13	9	X	12	7	13	11	11	10	11	11	9	11	12	9	11	12	9	11	-			
	2nd	X	X	9	X	X	11	X	X	13	2L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	-			
	3rd	X	X	10	X	X	13	X	X	X	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	3L	3L	3L	3L	3L	-			
-10	1st	X	10	4	X	10	5	15	9	7	12	9	8	9	9	9	9	10	10	9	10	10	9	10	-			
	2nd	X	12	5	X	13	7	X	13	10	2L	14	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-			
	3rd	X	14	6	X	X	9	X	X	12	2½L	2L	15	2½L	2L	2L	2½L	2½L	2½L	3L	3L	2½L	3L	3L	-			
-15	1st	X	6	1	X	6	1	14	6	3	11	7	5	9	8	7	9	9	8	9	9	9	9	10	-			
	2nd	X	8	1	X	9	3	X	10	6	2L	12	9	2L	14	12	2L	2L	14	2L	2L	2L	2L	2L	-			
	3rd	X	10	1	X	12	5	X	15	9	2L	2L	13	2L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	-			
-20	1st	15	2	1	14	3	1	13	4	1	10	5	2	8	6	4	8	8	6	8	8	8	8	9	-			
	2nd	X	4	1	X	6	1	X	8	2	2L	10	6	2L	13	9	2L	15	12	2L	2L	15	2L	2L	-			
	3rd	X	5	1	X	9	1	X	12	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2½L	2L	3L	3L	-			

VOLUME 43,000 (VEH./DAY)

SPEED 60 (M.P.H.)

%TRUCK 20%

%GRADE 4 TO

TABLE: 17-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3L	3L	3L	13	2½L	3L	11	15	2½L	10	14	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	3½L	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	3L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	4L	4L	4L	3½L	3L	3L	2½L	3L	3L	2½L	3L	2½L	3L
+15	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	3L	12	2½L	2½L	11	14	2½L	10	13	2L	9	12	15
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	3½L	3½L	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	2½L	3L
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L
+10	1st	X	X	X	X	X	X	X	X	X	3½L	3½L	2½L	3L	2½L	2½L	12	15	2½L	10	14	2L	10	13	15	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5	1st	X	X	X	X	X	X	X	X	X	3L	3L	2½L	2½L	2½L	2L	11	14	2L	10	13	15	10	12	14	9	12	14
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3L	2½L	15	2½L	2L	15	11	13	14	10	12	14	9	12	13	9	11	13
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	2½L	4L	3L	2½L	3½L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	3½L
-5	1st	X	X	10	X	X	12	X	X	13	2½L	2L	13	3L	15	13	11	12	13	10	11	13	9	11	12	9	11	12
	2nd	X	X	10	X	X	14	X	X	15	3L	2½L	2L	3L	2½L	2L	2½L	2L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L
	3rd	X	X	10	X	X	15	X	X	X	3½L	3L	3L	3½L	3L	2L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	3L
-10	1st	X	14	6	X	X	8	X	X	9	2½L	2L	10	15	13	10	10	11	11	9	11	11	9	11	12	9	10	12
	2nd	X	X	7	X	X	10	X	X	12	3L	2L	13	3L	2L	15	2L	2L	2L	2L	2L	2L	2L	2½L	2L	2½L	2½L	2½L
	3rd	X	X	8	X	X	11	X	X	15	3½L	2½L	2L	3½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L
-15	1st	X	10	1	X	14	4	X	X	6	2L	2L	7	15	12	9	10	10	11	9	10	10	9	10	11	9	10	11
	2nd	X	12	2	X	X	6	X	X	8	2½L	2L	11	2½L	2L	13	2L	2L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	2½L
	3rd	X	13	3	X	X	7	X	X	11	3L	2L	14	3L	2L	2L	3L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L
-20	1st	X	6	1	X	11	1	X	13	2	2L	2L	4	14	10	6	8	9	7	9	9	9	9	10	10	9	10	10
	2nd	X	8	1	X	14	2	X	X	5	2L	2L	8	2½L	2L	11	2L	2L	2L	2L	2L	15	2L	2L	2L	2L	2L	2L
	3rd	X	9	1	X	X	3	X	X	8	2½L	2L	12	3L	2L	15	2½L	2½L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L

VOLUME 64,000 (VEH./DAY) SPEED 60 (MPH) %TRUCK 20% %GRADE: 4 to 6

TABLE: 17-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)		RECEIVER HEIGHT (FLOORS)		DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																											
				110			170			250			380			570			850			1300			1900			2900			
				ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			
				1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
+20	1st	X	X	X	X	X	X	X	X	X	5L	4½L	4½L	4L	4L	4L	3L	3L	3L	12	2½L	2½L	10	14	2½L	10	13	2L			
	2nd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	4½L	4½L	4L	4L	4L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L			
	3rd	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	5½L	5½L	4½L	4½L	4½L	4L	3½L	4L	4L	3½L	3½L	4L	3½L	3½L	4L			
+15	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3L	3L	3L	12	2L	2½L	10	14	2L	10	13	2L			
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	3½L	3½L	3½L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L			
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4L	4½L	4½L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	3½L			
+10	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3½L	3½L	3L	3L	2½L	11	15	2½L	10	13	2L	10	12	15				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	3½L	4L	4L	3½L	3½L	3½L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L			
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L			
+5	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3½L	3L	2½L	2½L	2½L	11	14	2L	10	13	15	9	12	14			
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	4L	3L	3½L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L			
	3rd	X	X	X	X	X	X	X	X	X	5L	4L	3½L	4½L	4L	3½L	4½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L			
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	2½L	2½L	2½L	2L	11	13	15	10	12	14	9	12	14			
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3L	3½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L			
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3L	4L	4L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L			
-5	1st	X	X	15	X	X	X	X	X	X	3½L	3L	2L	3L	3L	2½L	2½L	2½L	15	11	13	14	10	12	13	9	11	13			
	2nd	X	X	15	X	X	X	X	X	X	4L	3L	2½L	3½L	3½L	3½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L			
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4½L	4L	4L	4L	3½L	3L	3½L	3L	3L	3L	3L	3L	3L	3L	3L			
-10	1st	X	X	11	X	X	14	X	X	X	3L	2½L	2L	3L	2½L	2L	2½L	2L	13	11	12	12	9	11	12	9	11	12			
	2nd	X	X	10	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2L	2½L	2L	2½L	2L	2½L	2L	2½L			
	3rd	X	X	12	X	X	X	X	X	X	4L	3L	2L	4L	3½L	2½L	4L	3½L	2½L	4L	3L	3L	3L	3L	3L	3L	3L	3L			
-15	1st	X		14	6	X	X	10	X	X	13	2½L	2L	15	2½L	2½L	14	15	2L	11	10	11	11	9	11	11	9	11	12		
	2nd	X	X	7	X	X	12	X	X	X	3L	2½L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L			
	3rd	X	X	7	X	X	14	X	X	X	3½L	2½L	2L	4L	3½L	2L	3½L	3L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L			
-20	1st	X	10	1	X	X	6	X	X	10	2½L	2L	12	2½L	2L	12	15	15	9	10	10	10	9	10	10	9	10	11			
	2nd	X	12	2	X	X	8	X	X	13	3L	2L	2L	3L	2½L	2L	3L	2½L	15	2½L	2L	2L	2L	2L	2L	2L	2L	2L			
	3rd	X	14	3	X	X	9	X	X	15	3½L	2½L	2L	3½L	3L	2L	3½L	3L	2L	3L	3L	2½L	3L	3L	3L	3L	3L	3L			

TABLE: 17-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			RCW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	6L	6L	5½L	5L	5½L	5½L	4L	4½L	5L	3½L	4L	3½L	14	2½L	2½L	11	14	2½L
	2nd	X	X	X	X	X	X	X	X	X	6½L	6L	5½L	6L	6L	5½L	5L	5½L	5½L	4L	4½L	4½L	3½L	3½L	3½L	2½L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6½L	6L	6½L	6½L	6L	6L	6L	5L	5½L	5L	4L	4L	4L	3½L	4L	4L	
+15	1st	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5L	5L	5L	4L	4½L	4½L	3½L	3½L	3½L	14	2½L	2½L	10	14	2L
	2nd	X	X	X	X	X	X	X	X	X	6½L	6L	5L	5½L	5½L	5L	5L	5L	4L	4½L	4½L	3½L	3½L	3½L	2½L	3L	3L	
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	5½L	6½L	6L	5½L	5½L	6L	5½L	5L	5L	5L	4L	4L	4L	3½L	3½L	4L
+10	1st	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4L	4½L	4½L	3L	3½L	3½L	14	2½L	2½L	10	13	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	5L	5L	4L	4½L	4L	3L	3L	3L	2½L	3L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6½L	6L	5L	6L	6L	5½L	5½L	5½L	5L	5L	5L	4L	4L	4L	3½L	3½L	4L	
+5	1st	X	X	X	X	X	X	X	X	X	5½L	5L	4L	4½L	4½L	4L	4L	4L	3L	3½L	3½L	14	2½L	2½L	10	13	2L	
	2nd	X	X	X	X	X	X	X	X	X	6L	5L	4½L	5½L	5L	4½L	4½L	5L	4L	4L	4L	3L	3L	3L	2½L	2½L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6L	5½L	4½L	5½L	5½L	5L	5L	4½L	4L	4L	4L	3½L	3½L	3½L	
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4½L	4L	3½L	4L	3½L	4L	3L	3½L	14	2L	2L	10	13	15
	2nd	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	5L	4½L	4½L	4½L	4L	4L	4L	3L	3L	3L	2½L	2½L	3L	
	3rd	X	X	X	X	X	X	X	X	X	6L	5L	4L	6L	5½L	4½L	5½L	5L	5L	4½L	5L	4½L	4L	4L	3½L	3½L	3½L	
-5	1st	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3½L	3½L	3½L	3L	3L	3L	14	2L	2L	10	12	14	
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	5L	4½L	4L	4½L	4½L	4L	4L	3½L	3L	3L	3L	2½L	2½L	2½L	
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3L	5½L	5L	4½L	5L	5L	4½L	4½L	4½L	4L	4L	3½L	3½L	3½L		
-10	1st	X	X	X	X	X	X	X	X	X	4½L	3½L	3L	4L	4L	3½L	3½L	3½L	3L	3L	3L	13	2L	15	10	12	14	
	2nd	X	X	X	X	X	X	X	X	X	5L	4L	3L	4½L	4½L	3½L	4½L	4L	4L	4L	3½L	3L	3L	2½L	2½L	2½L		
	3rd	X	X	X	X	X	X	X	X	X	5½L	4½L	3L	5½L	5L	4L	5L	5L	4½L	4½L	4½L	4L	4L	3½L	3½L			
-15	1st	X	X	12	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3½L	3L	3L	2½L	13	15	14	10	12	13	
	2nd	X	X	13	X	X	X	X	X	X	4½L	3½L	2½L	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3L	3L	2½L	2½L	2½L		
	3rd	X	X	14	X	X	X	X	X	X	5L	4L	3L	5L	4½L	3½L	5L	4½L	4L	4½L	4L	4L	3½L	3½L				
-20	1st	X	X	7	X	X	14	X	X	X	4L	3L	2L	3½L	3½L	2½L	3L	3L	3L	2½L	2½L	13	15	13	10	11	12	
	2nd	X	X	8	X	X	X	X	X	X	4½L	3L	2L	4½L	4L	3L	4L	4L	3½L	3½L	3L	3L	2½L	2½L				
	3rd	X	X	9	X	X	X	X	X	X	5L	3½L	2½L	5L	4½L	3½L	5L	4½L	4L	4½L	4L	4L	3½L	3½L				

VOLUME 140.000 (VEH./DAY)

SPEED 60 (M.P.H.)

%TRUCK 20%

%GRADE 4 TO

VOLUME: 140,000 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 4 to 6

TABLE: 17-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	X	7L	6L	6½L	6½L	6½L	5L	5½L	6L	4L	5L	5L	3½L	4L	4L	14	2½L	2½L
	2nd	X	X	X	X	X	X	X	X	X	X	X	6½L	7L	7L	6½L	6L	6½L	6½L	5L	5½L	6L	4L	4½L	5L	3½L	3½L	3½L
	3rd	X	X	X	X	X	X	X	X	X	X	X	6½L	X	X	7L	7L	7L	7L	6L	6½L	6½L	5L	5½L	5½L	4L	4½L	4½L
+15	1st	X	X	X	X	X	X	X	X	X	X	6½L	6L	6L	6½L	6L	5L	5½L	5½L	4L	4½L	5L	3L	3½L	4L	14	2½L	2½L
	2nd	X	X	X	X	X	X	X	X	X	X	7L	6L	7L	7L	6½L	6L	6L	6L	5L	5½L	5½L	4L	4½L	5L	3L	3½L	3½L
	3rd	X	X	X	X	X	X	X	X	X	X	X	6½L	X	X	7L	6½L	7L	6½L	6L	6L	6½L	5L	5½L	5½L	4L	4½L	4½L
+10	1st	X	X	X	X	X	X	X	X	X	7L	6½L	5½L	6L	6L	5½L	5L	5½L	5½L	4L	4½L	5L	3L	3½L	4L	14	2½L	2½L
	2nd	X	X	X	X	X	X	X	X	X	X	6½L	5½L	6½L	6½L	6L	5½L	6L	6L	5L	5½L	5½L	4L	4½L	4½L	3L	3½L	3½L
	3rd	X	X	X	X	X	X	X	X	X	X	7L	6L	X	7L	6½L	6½L	6½L	6½L	5½L	6L	6L	5L	5½L	5½L	4L	4½L	4L
+5	1st	X	X	X	X	X	X	X	X	X	6½L	6L	5L	6L	6L	5½L	5L	5L	5L	4L	4½L	4½L	3L	3½L	4L	14	2½L	2½L
	2nd	X	X	X	X	X	X	X	X	X	7L	6L	5L	6½L	6½L	5½L	5½L	6L	5½L	5L	5L	5L	4L	4½L	4½L	3L	3½L	3½L
	3rd	X	X	X	X	X	X	X	X	X	X	6½L	5½L	6½L	7L	7L	6L	6½L	6½L	6L	5L	5L	4L	4½L	4½L	3L	3½L	3½L
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	5½L	5½L	5½L	5L	5L	5L	4L	4½L	4½L	3L	3½L	3½L	14	2½L	2½L
	2nd	X	X	X	X	X	X	X	X	X	7L	6L	5L	6½L	6L	5½L	5½L	5½L	5½L	4½L	5L	5L	4L	4½L	4½L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	X	6L	5L	7L	7L	5½L	6½L	6½L	6L	5½L	6L	5½L	5L	5L	5L	4L	5L	5L
-5	1st	X	X	X	X	X	X	X	X	X	6L	5L	4L	5½L	5L	4½L	4½L	5L	4½L	4L	4L	4L	3L	3½L	3½L	14	2½L	2½L
	2nd	X	X	X	X	X	X	X	X	X	6½L	5½L	4½L	6L	6L	5L	5½L	5½L	5L	4½L	5L	5L	4L	4L	4L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	6L	4½L	7L	6L	5½L	6L	6L	5½L	5½L	5½L	5L	5L	5L	4L	4L	4L	4L
-10	1st	X	X	X	X	X	X	X	X	X	6L	5L	3½L	5½L	5L	4½L	4½L	4½L	4½L	3½L	4L	4L	3L	3½L	3½L	14	2L	2L
	2nd	X	X	X	X	X	X	X	X	X	6½L	5L	4L	6L	5½L	4½L	5L	5½L	5L	4½L	5L	4½L	4L	4L	4L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	7L	5½L	4L	6½L	6L	5L	6L	6L	5½L	5½L	5½L	5½L	5L	5L	5L	4L	4L	4L
-15	1st	X	X	X	X	X	X	X	X	X	5½L	4½L	3L	5L	4½L	4L	4½L	4½L	4L	3½L	4L	4L	3L	3L	3L	13	2L	2L
	2nd	X	X	X	X	X	X	X	X	X	6L	4½L	3½L	6L	5L	4½L	5L	5L	4½L	4½L	4½L	4L	4L	4L	3L	3L	3L	3L
	3rd	X	X	X	X	X	X	X	X	X	6½L	5L	3½L	6½L	5½L	4½L	6L	5½L	5L	5½L	5½L	4½L	5L	4½L	4L	4L	3½L	3L
-20	1st	X	X	15	X	X	X	X	X	X	5½L	4L	3L	5L	4½L	3½L	4L	4L	4L	3½L	3½L	3½L	3L	3L	3L	13	2L	2L
	2nd	X	X	15	X	X	X	X	X	X	5½L	4½L	3L	5½L	5L	4L	5L	5L	4½L	4½L	4½L	3½L	4L	4L	3L	3L	3L	3L
	3rd	X	X	15	X	X	X	X	X	X	6L	4½L	3½L	6L	5L	4½L	6L	5½L	5L	5L	5½L	4½L	5L	4½L	4L	4L	3½L	3L

VOLUME 220,000 (VEH/DAY)

SPEED 60 (MPH)

%TRUCK: 20%

%GRADE 4 to 6

TABLE: 18-1

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+15	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+10	1st	X	-	-	14	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+5	1st	14	-	-	12	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
GROUND LEVEL	1st	11	-	-	10	-	-																					
	2nd	15	-	-	15	-	-																					
	3rd	X	-	-	X	-	-																					
-5	1st	8	-	-	8	-	-																					
	2nd	12	-	-	14	-	-																					
	3rd	15	-	-	X	-	-																					
-10	1st	5	-	-	6	-	-																					
	2nd	9	-	-	12	-	-																					
	3rd	12	-	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	10	-	-																					
	3rd	10	-	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	7	-	-	13	-	-																					

VOLUME: 2,500 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 7+

TABLE: 18-2

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+15	1st	X	-	-	X	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+10	1st	X	-	-	14	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
+5	1st	14	-	-	12	-	-																					
	2nd	X	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
GROUND LEVEL	1st	11	-	-	10	-	-																					
	2nd	15	-	-	X	-	-																					
	3rd	X	-	-	X	-	-																					
-5	1st	8	-	-	8	-	-																					
	2nd	12	-	-	14	-	-																					
	3rd	15	-	-	X	-	-																					
-10	1st	5	-	-	6	-	-																					
	2nd	9	-	-	12	-	-																					
	3rd	13	-	-	X	-	-																					
-15	1st	2	-	-	4	-	-																					
	2nd	6	-	-	10	-	-																					
	3rd	10	-	-	15	-	-																					
-20	1st	1	-	-	2	-	-																					
	2nd	3	-	-	8	-	-																					
	3rd	7	-	-	14	-	-																					

VOLUME: 3,800 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 7+



TABLE: 18-3

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	-	-	15	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
+15	1st	X	X	-	X	-	-	14	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
+10	1st	X	X	-	14	-	-	12	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
+5	1st	14	X	-	12	-	-	11	-																			
	2nd	X	X	-	X	-	-	X	-																			
	3rd	X	X	-	X	-	-	X	-																			
GROUND LEVEL	1st	11	12	-	10	-	-	10	-																			
	2nd	15	13	-	X	-	-	X	-																			
	3rd	X	15	-	X	-	-	X	-																			
-5	1st	8	8	-	8	-	-	8	-																			
	2nd	12	9	-	14	-	-	15	-																			
	3rd	X	11	-	X	-	-	X	-																			
-10	1st	5	4	-	6	-	-	7	-																			
	2nd	9	5	-	12	-	-	14	-																			
	3rd	13	7	-	X	-	-	X	-																			
-15	1st	2	-	-	4	-	-	6	-																			
	2nd	6	-	-	10	-	-	13	-																			
	3rd	10	3	-	X	-	-	X	-																			
-20	1st	1	-	-	3	-	-	5	-																			
	2nd	3	-	-	8	-	-	11	-																			
	3rd	7	-	-	14	-	-	X	-																			

VOLUME  
5,600  
(VEH./DAY)

SPEED: 60  
(MPH)

%TRUCK: 20%

%GRADE: 7+

VOLUME 5,600 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 7+

TABLE: 18-4

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	-	X	X	-	15	X	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	-	X	X	-	14	X	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	-	14	X	-	13	X	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	-	13	15	-	11	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	-	X	X	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	-	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	14	12	-	11	12	-	10	12	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	-	X	15	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	-	X	X	-	X	X	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	11	8	-	9	8	-	9	9	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	14	9	-	14	11	-	15	13	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	-	X	14	-	X	X	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	8	4	-	7	5	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	12	5	-	12	8	-	14	11	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	15	7	-	X	11	-	X	15	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	5	1	-	5	2	-	6	4	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	9	1	-	10	5	-	13	8	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	13	3	-	X	8	-	X	12	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	2	1	-	3	-	-	5	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	6	1	-	8	-	-	12	5	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	10	1	-	14	4	-	X	10	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VOLUME 8,400 (VEH/DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 7+



TABLE: 18-5

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 13,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	15	X	-	13	3L	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	14	X	-	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3½L	3½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	15	X	X	13	X	-	11	15	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	13	15	X	11	14	-	10	14	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	-	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	12	12	12	12	12	10	14	-	10	12	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	15	14	X	X	X	X	X	-	2½L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5	1st	14	8	8	10	9	8	9	9	-	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	15	12	10	X	13	-	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	11	9	X	15	12	X	X	-	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10	1st	11	4	3	8	5	4	7	6	-	8	8	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	15	6	4	13	12	6	14	11	-	15	13	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	7	5	10	11	8	X	15	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-15	1st	8	1	-	6	2	-	6	4	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	12	2	-	11	5	2	13	8	-	15	11	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	3	-	X	8	4	X	12	-	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-20	1st	5	1	-	4	1	-	5	-	-	6	4	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	9	1	-	9	2	-	12	5	-	14	9	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd	13	1	-	15	5	-	X	10	-	2L	14	-	2L	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE: 18-6

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

VOLUME: 19,000 (VEH./DAY) SPEED: 60 (MPH) %TRUCK: 20% %GRADE: 7+

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	13	3L	3L	12	2½L	-	11	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3½L	3½L	3L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	4L	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+15	1st	X	X	X	X	X	X	15	X	X	12	2½L	3L	11	2½L	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3L	2½L	3L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3½L	3½L	-	3½L	-	-	-	-	-	-	-	-	-	-	-
+10	1st	X	X	X	X	X	X	13	X	X	12	15	2½L	11	15	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-
+5	1st	X	X	X	X	X	X	12	15	X	11	14	2L	10	13	-	10	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	3L	3L	-	3L	-	-	-	-	-	-	-	-	-	-	-
GROUND LEVEL	1st	X	13	12	X	12	13	11	12	13	10	12	13	9	11	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	14	13	X	15	14	X	X	X	2L	2L	2L	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	X	14	X	X	X	X	X	X	2½L	2L	2L	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-5	1st	X	9	8	14	9	9	9	9	9	9	10	10	9	10	-	9	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	10	8	X	12	10	X	14	12	2L	15	14	2L	2L	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	12	10	X	15	12	X	X	15	2L	2L	2L	2½L	2½L	-	3L	-	-	-	-	-	-	-	-	-	-	-
-10	1st	14	5	3	12	2	5	8	7	6	8	8	7	8	9	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	X	6	4	X	9	6	15	11	10	2L	13	11	2L	15	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	8	5	X	12	8	X	15	11	2L	2L	15	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-15	1st	11	1	1	10	2	1	7	4	2	7	6	4	8	7	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	15	2	1	15	5	2	13	8	5	15	11	8	2L	13	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	4	1	X	8	4	X	13	8	2L	2L	12	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-
-20	1st	8	1	1	8	1	1	5	2	-	6	4	-	7	6	-	8	-	-	-	-	-	-	-	-	-	-	-
	2nd	13	1	1	14	2	1	12	6	2	14	9	5	15	12	-	2L	-	-	-	-	-	-	-	-	-	-	-
	3rd	X	1	1	X	5	1	X	10	4	2L	15	9	2L	2L	-	2½L	-	-	-	-	-	-	-	-	-	-	-

TABLE 18-7

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	15	3L	3½L	12	2½L	3L	11	2½L	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3½L	2½L	3L	-						
	3rd	X	X	X	X	X	X	X	X	X	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3L	3½L	-						
+15	1st	X	X	X	X	X	X	X	X	X	14	2½L	3L	12	2½L	2½L	11	15	2½L	10	14	-						
	2nd	X	X	X	X	X	X	X	X	X	3L	3L	3½L	3L	3L	3L	2½L	3L	3L	2½L	3L	-						
	3rd	X	X	X	X	X	X	X	X	X	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-						
+10	1st	X	X	X	X	X	X	X	X	X	13	15	2½L	11	15	2½L	11	14	2L	10	13	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	-						
+5	1st	X	X	X	X	X	X	X	X	X	12	15	2L	11	14	2L	10	13	15	9	12	-						
	2nd	X	X	X	X	X	X	X	X	X	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	-						
GROUND LEVEL	1st	X	X	13	X	14	13	X	13	13	11	13	13	10	12	13	10	12	13	9	11	-						
	2nd	X	X	14	X	15	X	X	X	X	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	-						
	3rd	X	X	14	X	X	X	X	X	X	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	-						
-5	1st	X	12	8	X	11	9	15	10	10	10	11	11	9	11	11	9	11	11	9	11	-						
	2nd	X	14	8	X	13	11	X	15	13	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	-						
	3rd	X	X	10	X	X	12	X	X	15	2L	2L	2L	2½L	2½L	2½L	3L	2½L	2½L	3L	3L	-						
-10	1st	X	8	4	X	7	5	13	8	6	10	9	8	9	9	9	9	10	10	9	10	-						
	2nd	X	10	4	X	10	7	X	12	10	2L	14	9	2L	15	14	2L	2L	2L	2L	2L	-						
	3rd	X	2	5	X	13	8	X	X	12	2L	2L	15	2½L	2L	2L	2½L	2½L	2L	3L	3L	-						
-15	1st	15	4	1	14	4	1	12	5	3	9	7	5	8	8	7	8	8	8	8	9	-						
	2nd	X	6	1	X	7	3	X	9	6	2L	12	9	2L	14	11	2L	2L	14	2L	2L	-						
	3rd	X	8	1	X	10	4	X	14	8	2L	2L	12	2L	2L	2L	2½L	2½L	2L	3L	2½L	-						
-20	1st	13	1	1	12	1	1	11	3	1	8	5	2	8	6	4	8	7	5	8	8	-						
	2nd	X	2	1	X	3	1	X	7	2	15	10	6	2L	13	9	2L	14	12	2L	2L	-						
	3rd	X	3	1	X	6	1	X	11	5	2L	15	9	2L	2L	14	2½L	2L	2L	2½L	2½L	-						

VOLUME: 28,000 (VEH/DAY) SPEED: 60 (M.P.H.) %TRUCK: 20% %GRADE: 7+

TABLE 18-8

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																										
		110			170			250			380			570			850			1300			1900			2900		
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
+20	1st	X	X	X	X	X	X	X	X	X	3½L	3L	3½L	13	2½L	3L	11	2½L	3L	10	15	2½L	10	13	2L	-		
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L	-		
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	4L	4L	4L	4L	3½L	3½L	4L	3½L	3½L	4L	3½L	3½L	4L	-		
+15	1st	X	X	X	X	X	X	X	X	X	3L	3L	3L	13	2½L	3L	11	15	2½L	10	14	2½L	10	13	2L	-		
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	3L	3L	3L	2½L	3L	3L	2L	3L	3L	2½L	2½L	3L	-		
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-		
+10	1st	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	12	2L	2½L	11	14	2½L	10	13	2L	9	12	15	-		
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	3L	2½L	3L	3L	2½L	2½L	3L	2½L	2½L	3L	2½L	2½L	2½L	-		
	3rd	X	X	X	X	X	X	X	X	X	4L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	-		
+5	1st	X	X	X	X	X	X	X	X	X	2½L	2L	2L	12	14	2L	10	13	15	10	12	15	9	12	14	-		
	2nd	X	X	X	X	X	X	X	X	X	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-		
	3rd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3½L	3½L	3½L	3½L	3½L	-		
GROUND LEVEL	1st	X	X	13	X	X	14	X	X	14	2½L	2L	14	11	13	14	10	12	14	9	12	13	9	11	13	-		
	2nd	X	X	14	X	X	15	X	X	X	3L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	-		
	3rd	X	X	15	X	X	X	X	X	X	3½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	3L	3L	3L	3L	3L	3L	-		
-5	1st	X	X	9	X	X	10	X	15	10	15	12	11	11	11	12	10	11	12	9	11	12	9	11	12	-		
	2nd	X	X	10	X	X	11	X	X	13	2½L	2L	15	2L	2L	2L	2L	2L	2L	2L	2L	2½L	2½L	2½L	2½L	-		
	3rd	X	X	11	X	X	13	X	X	X	3L	2L	2L	3L	2½L	2½L	3L	3L	2½L	3L	3L	3L	3L	3L	3L	-		
-10	1st	X	12	4	X	12	5	X	12	7	14	10	8	10	10	9	9	10	10	9	10	11	9	10	11	-		
	2nd	X	14	5	X	15	7	X	X	10	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L	2L	-		
	3rd	X	15	6	X	X	9	X	X	12	2½L	2L	12	2½L	2L	2L	2½L	2½L	2½L	3L	3L	2½L	3L	3L	3L	-		
-15	1st	X	8	1	X	9	1	X	10	3	13	8	5	9	8	7	9	9	8	9	9	9	9	10	10	-		
	2nd	X	10	1	X	12	3	X	14	6	2L	13	9	2L	15	12	2L	2L	14	2L	2L	2L	2L	2L	2L	-		
	3rd	X	11	1	X	15	5	X	X	9	2½L	2L	13	2½L	2L	2L	2½L	2½L	2L	3L	2½L	2½L	3L	3L	3L	-		
-20	1st	X	4	1	X	6	1	15	7	1	13	6	2	9	7	5	8	8	7	8	9	8	8	9	9	-		
	2nd	X	6	1	X	9	1	X	11	3	2L	11	5	2L	13	10	2L	15	12	2L	2L	15	2L	2L	2L	-		
	3rd	X	7	1	X	12	1	X	X	5	2L	2L	10	2L	2L	14	2½L	2L	2L	3L	2½L	2½L	3L	3L	2½L	-		

TABLE 18-9

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																											VOLUME 64,000 (VEH./DAY)	SPEED - 60 MPH)	% TRUCK : 20%	% GRADE : 7+
		110			170			250			380			570			850			1300			1900			2900						
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW						
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd				
+20	1st	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	3½L	3½L	3½L	15	2½L	3L	11	2L	2½L	10	14	2½L	10	13	2½L				
	2nd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	3½L	3½L	3½L	3L	3L	3½L	2½L	3L	3L	2½L	2½L	3L					
	3rd	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	4½L	4L	4L	4L	3½L	4L	4L	3½L	4L	4L	3½L	3½L	4L					
+15	1st	X	X	X	X	X	X	X	X	X	4L	4L	3½L	3½L	3½L	3L	15	2½L	2½L	11	15	2½L	10	13	2½L	10	12	2L				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4½L	4L	4L	4L	3½L	3½L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L				
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L					
+10	1st	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3L	3L	2½L	15	2½L	2½L	11	14	2L	10	13	2L	9	12	15				
	2nd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4L	3½L	3L	3L	3L	2½L	3L	3L	2½L	3L	3L	2½L	2½L	3L					
	3rd	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4L	3½L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L					
+5	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3L	3L	2½L	14	15	2L	10	13	2L	10	12	15	9	12	14				
	2nd	X	X	X	X	X	X	X	X	X	4L	3½L	3L	3½L	3L	2½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L					
	3rd	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L					
GROUND LEVEL	1st	X	X	X	X	X	X	X	X	X	3½L	3L	2L	3L	2½L	2L	14	14	15	10	13	14	10	12	14	9	11	13				
	2nd	X	X	X	X	X	X	X	X	X	3½L	3L	2½L	3½L	3L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L					
	3rd	X	X	X	X	X	X	X	X	X	4L	3½L	2½L	4L	3½L	3L	3½L	3L	3L	3½L	3½L	3L	3½L	3½L	3½L	3½L	3½L					
-5	1st	X	X	13	X	X	15	X	X	X	3L	2½L	2L	2½L	2½L	14	13	13	13	10	12	13	9	11	13	9	11	13				
	2nd	X	X	14	X	X	X	X	X	X	3½L	3L	2L	3½L	3L	2L	3L	2½L	2L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	2½L					
	3rd	X	X	14	X	X	X	X	X	X	4L	3L	2L	4L	3½L	2½L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L					
-10	1st	X	X	8	X	X	11	X	X	13	2½L	2L	13	2½L	2L	12	13	12	12	10	11	12	9	11	12	9	11	12				
	2nd	X	X	9	X	X	13	X	X	X	3L	2½L	2L	3L	2½L	2L	2L	2L	2L	2½L	2L	2L	2½L	2½L	2½L	2½L	2½L					
	3rd	X	X	10	X	X	15	X	X	X	3½L	2½L	2L	4L	3L	2L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L	3L	3L					
-15	1st	X	12	3	X	X	8	X	X	X	2½L	2L	10	2½L	2L	9	13	11	10	9	10	10	9	10	11	9	10	11				
	2nd	X	14	4	X	X	9	X	X	13	3L	2L	14	3L	2½L	14	2½L	2L	2L	2L	2L	2L	2L	2L	2L	2½L	2½L					
	3rd	X	15	5	X	X	11	X	X	15	3½L	2½L	2L	3½L	3L	2L	3½L	2½L	2L	3L	3L	2½L	3L	3L	3L	3L	3L					
-20	1st	X	8	1	X	13	3	X	X	5	2L	2L	7	2L	15	7	12	10	8	9	10	9	9	10	10	9	10	11				
	2nd	X	10	1	X	5	X	X	9	X	2½L	2L	11	2½L	2L	12	2½L	2L	14	2L	2L	2L	2L	2L	2L	2L	2L					
	3rd	X	11	1	X	X	7	X	X	12	3L	2L	15	3½L	2½L	2L	3L	2½L	2L	3L	2½L	2½L	3L	1½L	2½L	3L	3L	3L				

VOLUME 64,000 (VEH/DAY) SPEED 60 (MPH) %TRUCK 20% %GRADE 7+

TABLE 18-10

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																												
		110			170			250			380			570			850			1300			1900			2900				
		ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW			ROW				
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd		
+20		1st	X	X	X	X	X	X	X	X	X	X	5½L	5½L	5L	4½L	5L	5L	3½L	3½L	3½L	15	2½L	3L	11	15	2½L	10	13	2L
		2nd	X	X	X	X	X	X	X	X	X	X	6L	6L	5L	5½L	5½L	5L	4L	4½L	4L	3½L	3½L	3½L	2½L	3L	3L	2½L	3L	3L
		3rd	X	X	X	X	X	X	X	X	X	X	6½L	6L	5½L	6L	6L	5½L	5L	5L	5L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L
+15		1st	X	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	4½L	4½L	4L	3½L	3½L	3½L	15	2½L	2½L	11	14	2½L	10	13	2L
		2nd	X	X	X	X	X	X	X	X	X	X	6L	5½L	5L	5L	5L	4L	4L	4L	3½L	3L	3½L	2½L	3L	3L	2½L	2½L	3L	3L
		3rd	X	X	X	X	X	X	X	X	X	X	6½L	5½L	5L	6L	5½L	5½L	5L	5L	4½L	4L	4L	4L	3½L	4L	4L	3½L	3½L	4L
+10		1st	X	X	X	X	X	X	X	X	X	X	5L	4½L	4L	4½L	4½L	4L	3L	3½L	3L	14	2½L	2½L	11	14	2L	10	13	15
		2nd	X	X	X	X	X	X	X	X	X	X	5½L	5L	4½L	5L	5L	4½L	4L	4L	3½L	3L	3L	3L	2½L	3L	3L	2½L	2½L	3L
		3rd	X	X	X	X	X	X	X	X	X	X	6L	5½L	4½L	5½L	5½L	5L	4½L	4L	4L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
+5		1st	X	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4L	4L	4L	3L	3L	3L	14	2L	2L	10	13	2L	10	12	15
		2nd	X	X	X	X	X	X	X	X	X	X	5½L	4½L	4L	5L	4½L	4L	4L	3½L	3L	3L	3L	2½L	2½L	3L	2½L	2½L	2½L	
		3rd	X	X	X	X	X	X	X	X	X	X	5½L	5L	4L	5½L	5L	4½L	4½L	4L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
GROUND LEVEL		1st	X	X	X	X	X	X	X	X	X	X	4½L	4L	3½L	4L	4L	3½L	3L	3L	2½L	14	15	2L	10	13	15	10	12	14
		2nd	X	X	X	X	X	X	X	X	X	X	5L	4½L	3½L	4½L	4½L	4L	3½L	3½L	3L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	
		3rd	X	X	X	X	X	X	X	X	X	X	5½L	4½L	3½L	5½L	5L	4L	4½L	4½L	3½L	4L	3½L	3½L	3½L	3½L	3½L	3½L	3½L	3½L
-5		1st	X	X	X	X	X	X	X	X	X	X	4L	3½L	3L	4L	3½L	3L	3L	3L	2½L	14	15	15	10	12	14	9	12	13
		2nd	X	X	X	X	X	X	X	X	X	X	4½L	4L	3L	4½L	4L	3½L	3½L	3½L	3L	3L	2½L	2½L	2½L	2½L	2½L	2½L	2½L	
		3rd	X	X	X	X	X	X	X	X	X	X	5L	4L	3½L	5L	4½L	4L	4½L	4L	3L	4L	3½L	3L	3½L	3½L	3½L	3½L	3½L	3½L
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		2nd	X	X	15	X	X	X	X	X	X	X	4½L	3L	2½L	4½L	4L	3L	3L	2½L	2½L	2½L	3L	2½L	2½L	2½L	2½L	2½L	2½L	
		3rd	X	X	X	X	X	X	X	X	X	X	5L	4L	3L	5L	4½L	3½L	4½L	4L	3L	3½L	3½L	3L	3L	3L	3L	3L	3L	3L
-15		1st	X	X	9	X	X	15	X	X	X	X	3½L	3L	2L	3½L	3L	2½L	2½L	2½L	2L	13	13	12	10	11	12	9	11	12
		2nd	X	X	10	X	X	X	X	X	X	X	4L	3L	2L	4L	3½L	3L	3½L	3L	2½L	2L	3L	2½L	2L	2½L	2½L	2½L	2½L	
		3rd	X	X	11	X	X	X	X	X	X	X	4½L	3L	2½L	4½L	4L	3L	4L	3½L	3L	3½L	3L	3L	3L	3L	3L	3L	3L	3L
-20		1st	X	X	5	X	X	11	X	X	X	X	3½L	2½L	2L	3L	3L	2L	2½L	2L	14	13	12	11	9	11	11	9	10	11
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		3rd	X	X	7	X	X	15	X	X	X	X	4L	3L	2L	4½L	4L	3L	4L	3½L	2½L	3½L	3L	2½L	3L	3L	3L	3L	3L	3L

VOLUME: 96,000 (VEH./DAY)

SPEED: 60 (M.P.H.)

%TRUCK: 20%

%GRADE: +/



TABLE 18-11

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT)																														VOLUME 140,000 (VEH/DAY)	SPEED 60 (MPH)	%TRUCK 20%	%GRADE: 7+																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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VOLUME 140,000 (VEH./DAY) SPEED 60 (MPH) %TRUCK 20% %GRADE 7+

TABLE 18-12

MINIMUM BARRIER OR BUILDING HEIGHT NECESSARY TO  
ACHIEVE RECOMMENDED SOUND LEVEL LIMITS

ROAD ELEVATION (FT.)	RECEIVER HEIGHT (FLOORS)	DISTANCE FROM EDGE OF PAVEMENT TO FIRST ROW OF HOUSING (FT.)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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## 7. A DISCUSSION OF THE APPLICATION OF NOISE CONTROL MEASURES

The term "Noise Control Measures" is one which refers to any action which could be taken to reduce noise levels on a site to acceptable levels and thus achieve compatibility for the specific land use or activity. A summary of noise control measures is shown in Fig. 7.1. This Section of the Tables will discuss the noise control measures indicated in Fig. 7.1 and provide examples and suggestions on how specific noise control measures can be instituted on a given site. This Section is thus useful background material to the Barrier Tables themselves and can be used to expand on the general concept of noise control measures as indicated by the Tables. Although many of the examples given in this Section are based on actual site designs, specific architectural design will still be necessary after the indications provided by these Tables have been taken into account. The Barrier Tables and this Section provide the broad concept of site noise control on a particular subdivision. Further architectural design will be required to bring the project to the final design stage.

### 7.1 SITE PLANNING AS A NOISE CONTROL MEASURE

Site planning is a relatively simple and effective technique for reducing the impact of roadway noise on a new development. In general, it involves arranging buildings, facilities and recreational areas in such a way as to provide maximum protection for noise sensitive uses by placing them away from the roadway. Noise insensitive uses on the other hand are placed close to the roadway. The usefulness of site planning will be affected by such factors as the inherent flexibility available, existing or proposed designation in Official Plans or Zoning-Bylaws, the relative size of proposed buildings and the site itself, and the form or density of development intended for the land. The available site planning techniques are as follows:



#### 7.1.1 Distance Setback

Increasing the distance between a residential building or any noise sensitive areas and the roadway can be a useful means of reducing sound levels. Distance setback is most useful where noise sensitive areas are already close to the roadway. For example if a noise sensitive use, such as front yard were located some 30 feet from a roadway, then a 9 dB decrease in the sound level would be achieved if the front yard were moved back to 120 ft. If, however, the front yard were located 300 feet from the roadway, to gain the same 9 dB decrease in sound level the setback would have to be increased to 1200 feet. Thus, the use of distance alone as a noise control measure is most effective closest to the roadway.

Distance is, however, one of the very few noise control measures suitable for obtaining acceptable sound levels on the balconies of apartment buildings which overlook a roadway, as the use of a barrier is prohibited by the very height of the balconies themselves. The balconies could, of course, be removed or placed solely on the other side of the building, a technique which is discussed later on.

#### 7.1.2. Insertion of Noise Insensitive Land Uses

Land vacated using distance setback need not necessarily be left unused. It can be used for practically any land use, so long as that use itself does not produce excessive noise levels.

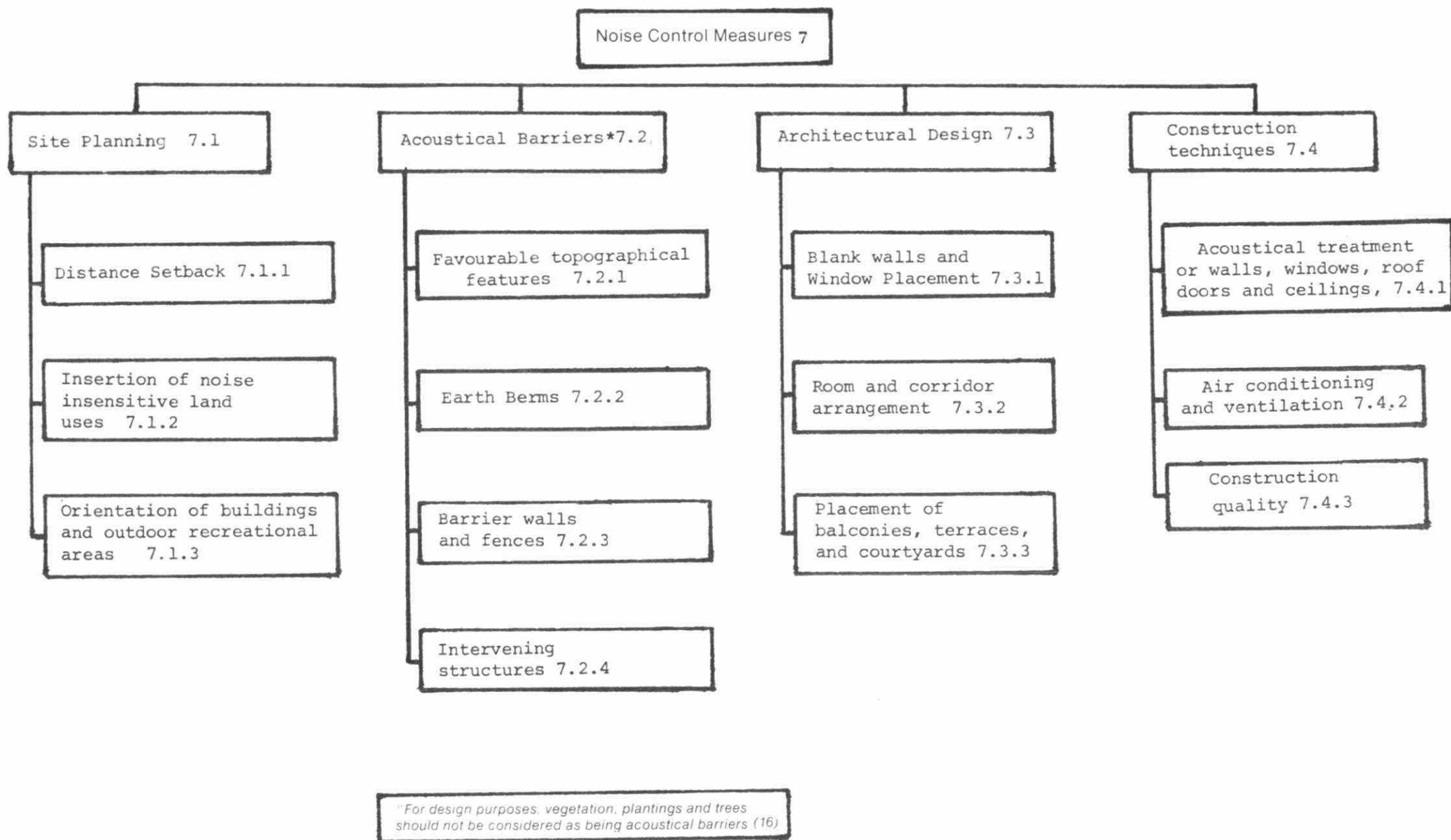


Figure 7.1

Summary of Noise Control Measures Applicable to Land Use Planning

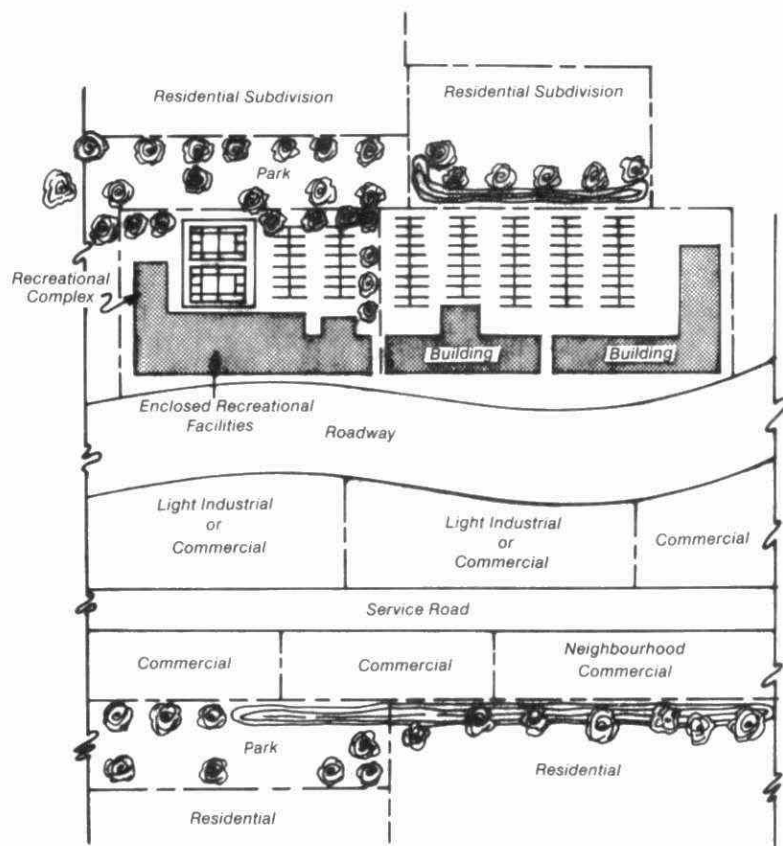


Figure 7.2 The Use of Noise-Insensitive Land, such as Commercial, Industrial, and Enclosed Recreational Areas as Sound Barriers

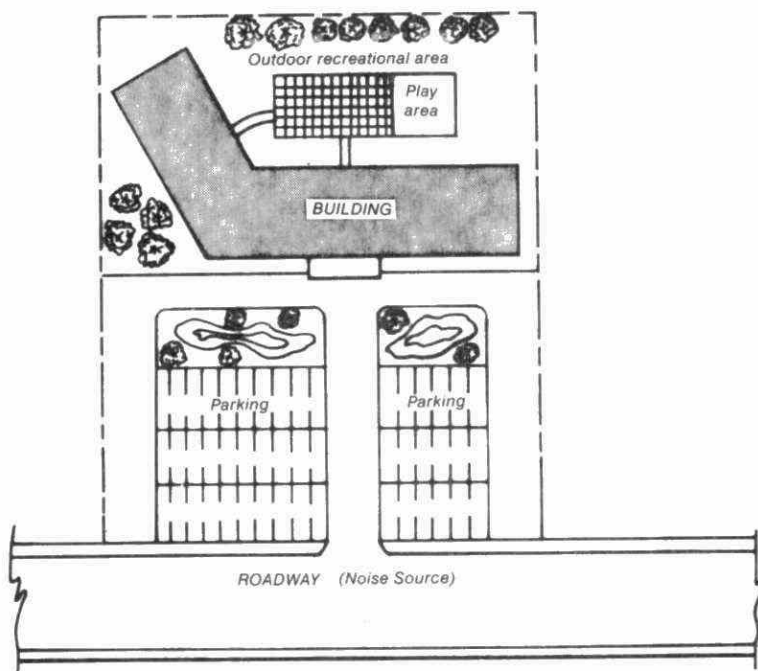


Figure 7.3 The Use of Parking Area as a Sound Buffer

noise levels. The noise insensitive land use can be necessary to the subdivision itself, such as parking, or can be usage not connected with the subdivision at all, such as light industry or commercial development. If, of course, actual buildings are used as a large part of the noise insensitive usage then a further decrease in sound levels could be achieved, which could allow a reduction in the original distance setback and release more land for residential purposes. Figures 7.2 and 7.3 provide schematic illustration of the use of noise insensitive land uses as buffers offering various degrees of noise reduction on the noise sensitive or residential areas.

#### 7.1.3 Orientation of Buildings and Outdoor Recreation Areas

An acceptable noise environment can often be achieved in outdoor recreation areas on a subdivision by careful orientation of these areas and the buildings on the site. Once outdoor noise levels have been reduced in this way, indoor noise levels can be controlled using further techniques outlined later on in Sections 7.3 and 7.4 <sup>(9)</sup>

An outdoor recreation area is considered to be any area where quiet is of importance such as:

- (a) yards such as the front yards, backyards, gardens, terraces or patios of dwellings;
- (b) common outdoor areas allocated for recreational purposes such as areas outside apartment buildings, condominiums, group homes and hospitals;
- (c) parks and open spaces allocated for quiet recreational purposes within a subdivision.

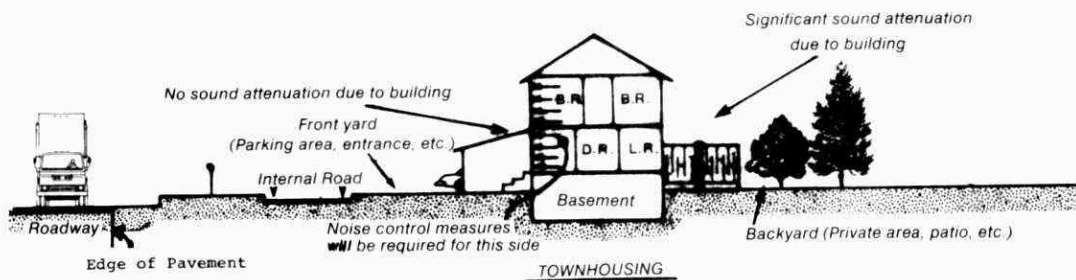


Figure 7.4 The Use of Building Barriers to Create an Acoustical Shadow Zone

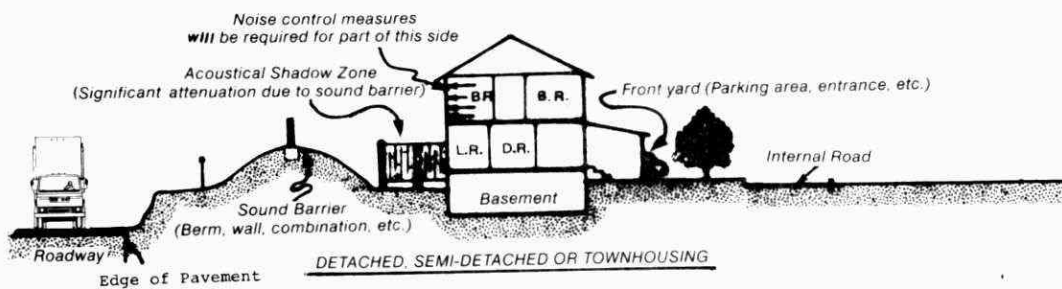


Figure 7.5 The Use of a Sound Barrier to Create an Acoustical Shadow Zone



Consideration should always be given to placing areas such as these, where the enjoyment of the outdoor environment is important, so that they are shielded from sound by a building. When considering townhouse development, it is customary to provide a front yard and a back yard for each unit. The back yard is the area which the resident exclusively uses for his outdoor recreational activities such as relaxation, conversation, etc. Thus, the back yard should be shielded and placed with the townhouse between it and the roadway. The front yard is of considerably less importance than the back yard being used primarily for parking and seldom for recreational purposes. (See Fig. 7.4.)

Use of this technique necessitates a single side use internal road, and near continuous row townhousing but provides a larger degree of protection from noise from both the back yards and housing behind the barrier row. An alternative technique (Fig. 7.5), using a more conventional layout with a two side use internal road and single family residences, is to protect the back yard using a berm, wall or combination thereof as a barrier. This alternative technique, can only be built to a certain height due to structural and aesthetic considerations. Further discussion on the use of berms as a noise control measure is presented in Sections 7.2.2 and 7.2.3.

## 7.2 ACOUSTICAL BARRIERS

An acoustical barrier is an obstacle placed between the roadway and the noise-sensitive area or residential unit to interrupt or impede the propagation of the emitted sound waves. An acoustical barrier is one of the useful and practical methods of reducing noise from road traffic. Acoustical barriers may be natural, such as significant topographical variations between the traffic lanes and the receiver, (Figure 7.6) or the existing ones such as intervening

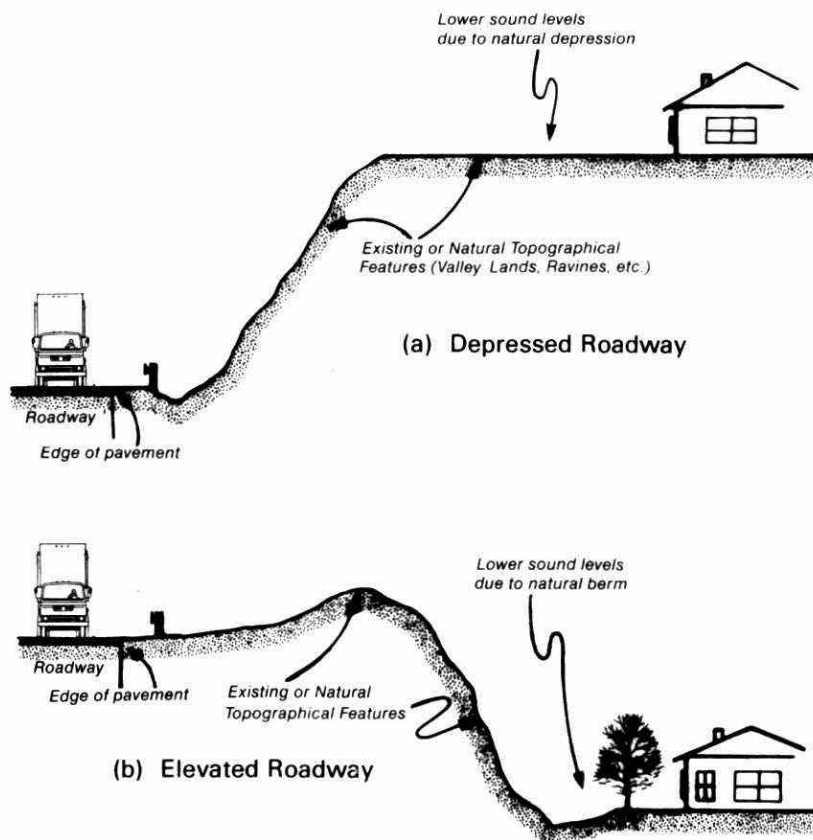


Figure 7.6 Lower Sound Levels Created by Existing or Natural Topographical Features

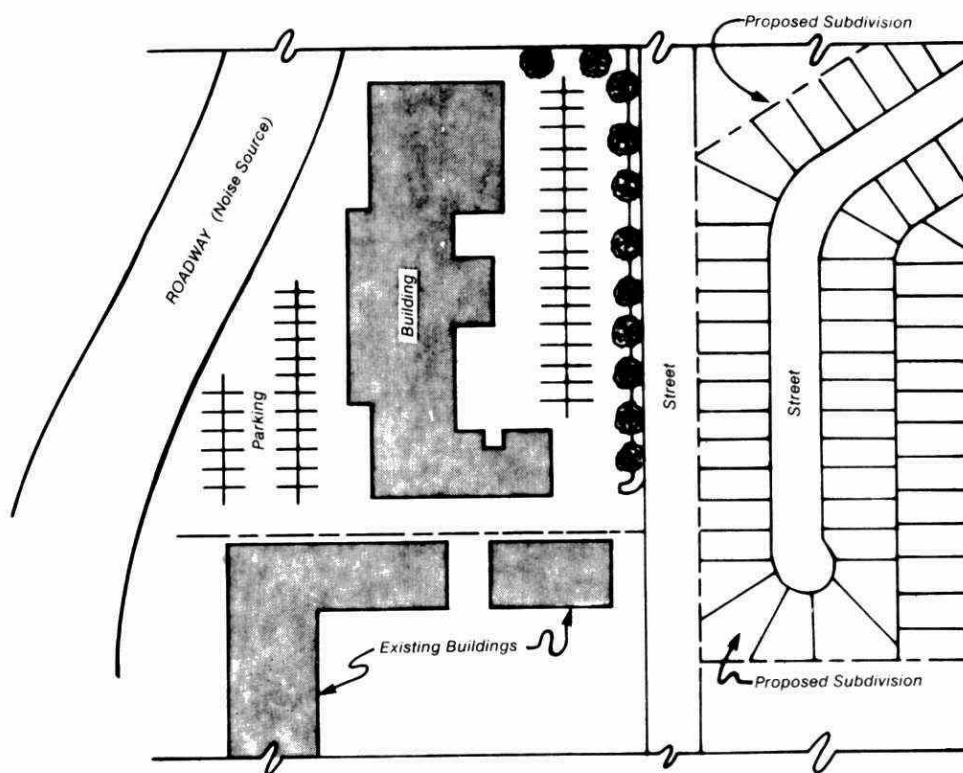


Figure 7.7 Lower Noise Levels Zone Created by Intervening Structures or Buildings

structures or buildings, (Figure 7.7). Deliberately created barriers may include earth berms and walls as well as buildings used as noise barriers. Obviously the choice of which alternative to use depends upon such considerations as space, cost, safety, aesthetics and the desired sound level reduction.

The expected sound level reduction due to the barrier is dependent on the path length difference it provides (see Figure 7.8 and Section 8.4) and the dimensions and mass density of the barrier. For a barrier to be effective, it should be positioned, when feasible, as close as possible to either the roadway or the receiver thus maximizing the path length difference for a given barrier height, or alternatively reducing the barrier height required. The barrier may well be required to provide attenuation for a receiver in an outdoor recreational area or on a balcony at an elevated level in a residential dwelling unit as shown on Figure 7.9. This second example will require a much higher barrier.

In general, barriers must be long and continuous, or alternatively, wrapped around the area to be protected thus preventing sound from passing around the ends. The barrier must be solid, with no holes, gaps or openings to provide the maximum theoretical decrease in sound level. Some barriers offer the option of having a sound absorptive surface on the noisy side to further lower sound levels.

Safety is another important consideration in barrier construction which may necessitate consideration of such requirements as slope, stability, visibility at roadway intersections and the use of guard or crash rails on high speed roadways.

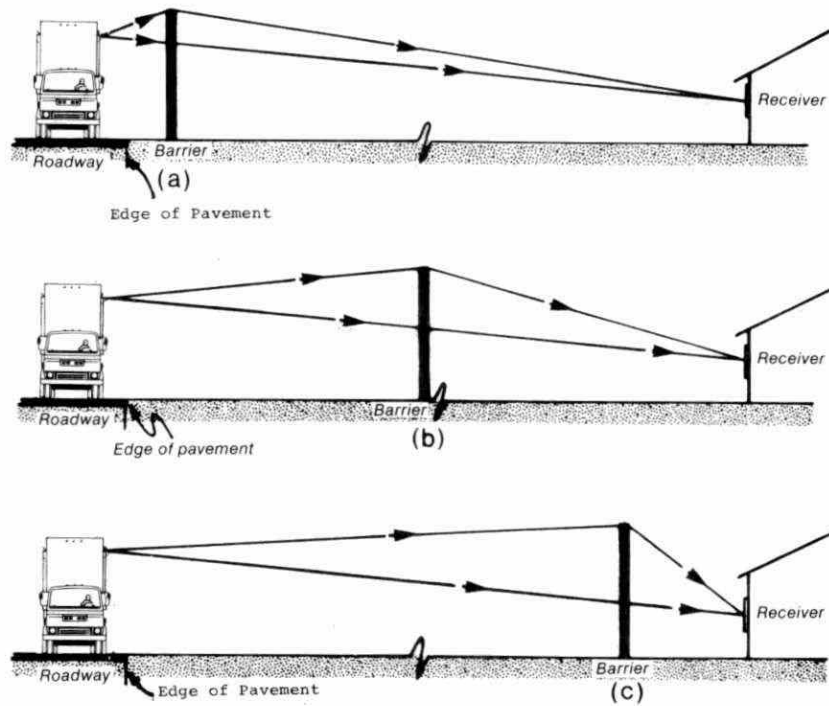


Figure 7.8 Possible Sound Barrier Locations with Respect to Receiver and Roadway

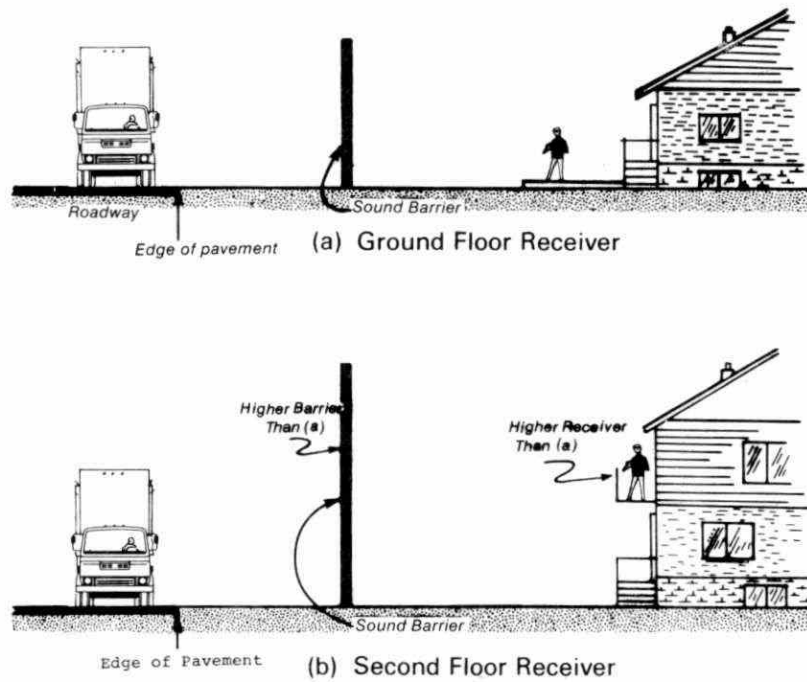


Figure 7.9 Barrier Height Required For Two Receiver Positions

The detailed design and construction of a noise barrier, such as a berm or wall, is a subject which could require consideration of several parameters such as cost of installation, structural stability, strength, durability, servicing and maintenance, as well as the other parameters discussed above. The detailed design of a noise barrier is beyond the scope of this work.

#### 7.2.1 Favourable Topographical Features

Noise-sensitive activities and buildings can also be oriented on a site in such a way that the site's natural topographical features (natural berms or cut situations) between roadway and receiver provide some attenuation of noise levels. Such features may be added to, or wholly created by, excavation or landfilling to establish the necessary acoustical shielding. These features would act as noise barriers by obstructing the traffic generated sound waves and thereby reduce the noise impact on the nearby residents. Topographical features and changes should be considered in the early planning stages to determine what the most suitable noise control method is for a given land strip adjacent to a roadway. The sufficiency of such simple noise control measures should be established by investigating the topography in the area and then determining whether additional noise control measures are required on the actual site.

#### 7.2.2 Earth Berms

Berms, long and sloping mounds of earth, running parallel



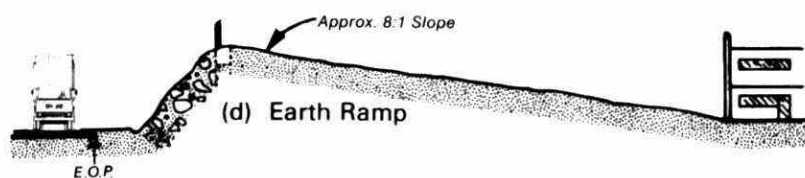
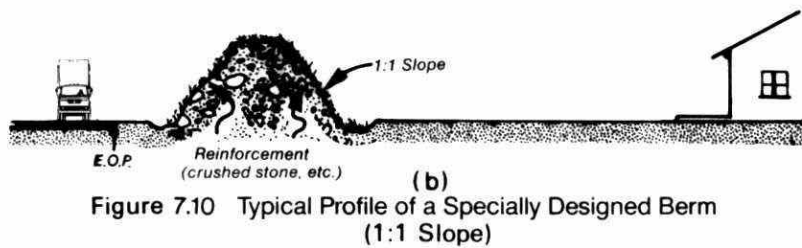
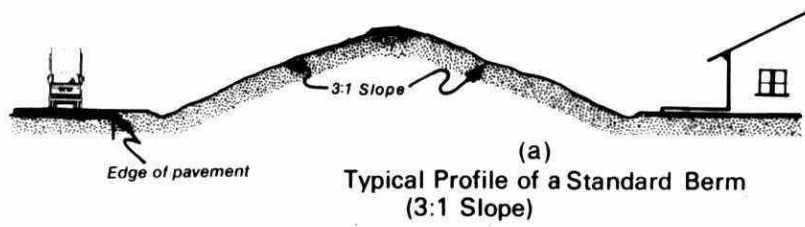


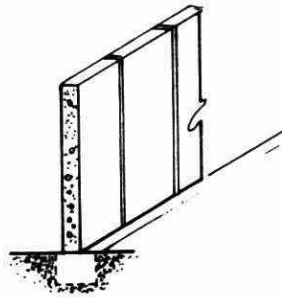
Figure 7.11 Typical Profile of Earth Berms (Sound Barriers) and Complementary Uses

to the roadway, are one of the methods of producing a deliberately created acoustical barrier. Berms can range up to 15 feet in height and still be considered satisfactory from aesthetic considerations although some reports cite fifty feet as being an upper limit. The higher the berm, the greater the width of land required for its construction (approximately 6 times its height if not specially designed, see Fig. 7.10). Because of the amount of land required, a berm is not always the most feasible method of reducing traffic noise. Figure 7.11 illustrates some typical advanced berm designs. <sup>(10)</sup>

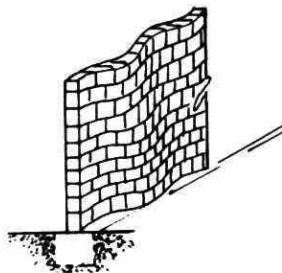
Earth berms possess the advantages of:

- i) deflecting the sound waves upward (instead of reflecting them from one side of the roadway to another) thus reducing the noise perceived on the opposite side of the roadway;
- ii) providing absorptive surfaces (as compared to bare walls) on both sides of the roadway which further reduce the effects of reflected sound waves;
- iii) easily meeting the minimum mass requirements of  $4 \text{ lb./ft.}^2$ ;
- iv) providing a more appealing and aesthetically pleasing acoustic barrier as compared to walls for both motorists and residents.

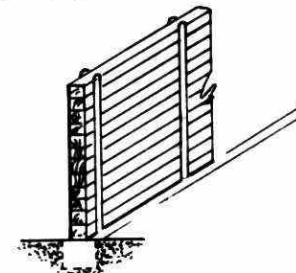
Great care should, however, be taken in the landscaping of berms, particularly with respect to tree, shrub bush plantings which can scatter sound waves downwards and remove at least part of the sound attenuation berms provide.



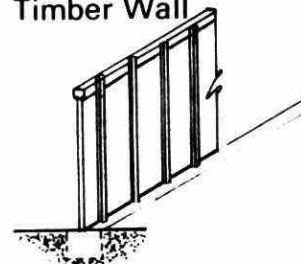
(a) Concrete Wall (Precast or Poured in Place)



(b) Brick Wall



(c) Timber Wall



(d) Sheet Metal or Solid Wood Fence

Figure 7.12 Typical Acoustical Barrier Walls  
and Fences  
(No gaps or openings permitted)

It may be found that insufficient space exists for the construction of a berm up to the height specified in the Barrier Tables. In this case it may be necessary to use a berm/wall or fence combination up to the same height. For instance, if a 14 ft. berm is required, space could be saved by using a 6 ft. solid wood fence on an 8 ft. berm, thus achieving the necessary height. A discussion of walls and fences follows.

#### 7.2.3 Barrier Walls and Fences

Acoustical barrier walls and fences exist in many designs and material variations. Basically, any solid continuous structure will suffice as a barrier provided it is of adequate mass (not less than 4 lb./ft.<sup>2</sup>) and has no holes or gaps. Walls and fences offer several advantages over berms, they require minimum space, maintenance is easier and they are capable of providing physical separation from the roadway when desired, keeping people from entering the roadway. For safety, privacy, visual screening and to reduce the amount of debris, salt and slush from the roadway, walls are desirable. One of the major disadvantages of using walls or specially designed acoustical fences is that great lengths of walling, especially high ones, tend to be aesthetically monotonous. Figure 7.12 illustrates typical acoustical walls and fences.

#### 7.2.4 Intervening Structures

In built-up residential or commercial areas, the first row of buildings along a roadway can be used to provide a significant reduction of traffic noise levels in areas behind that row of buildings. In fact, the use of intervening

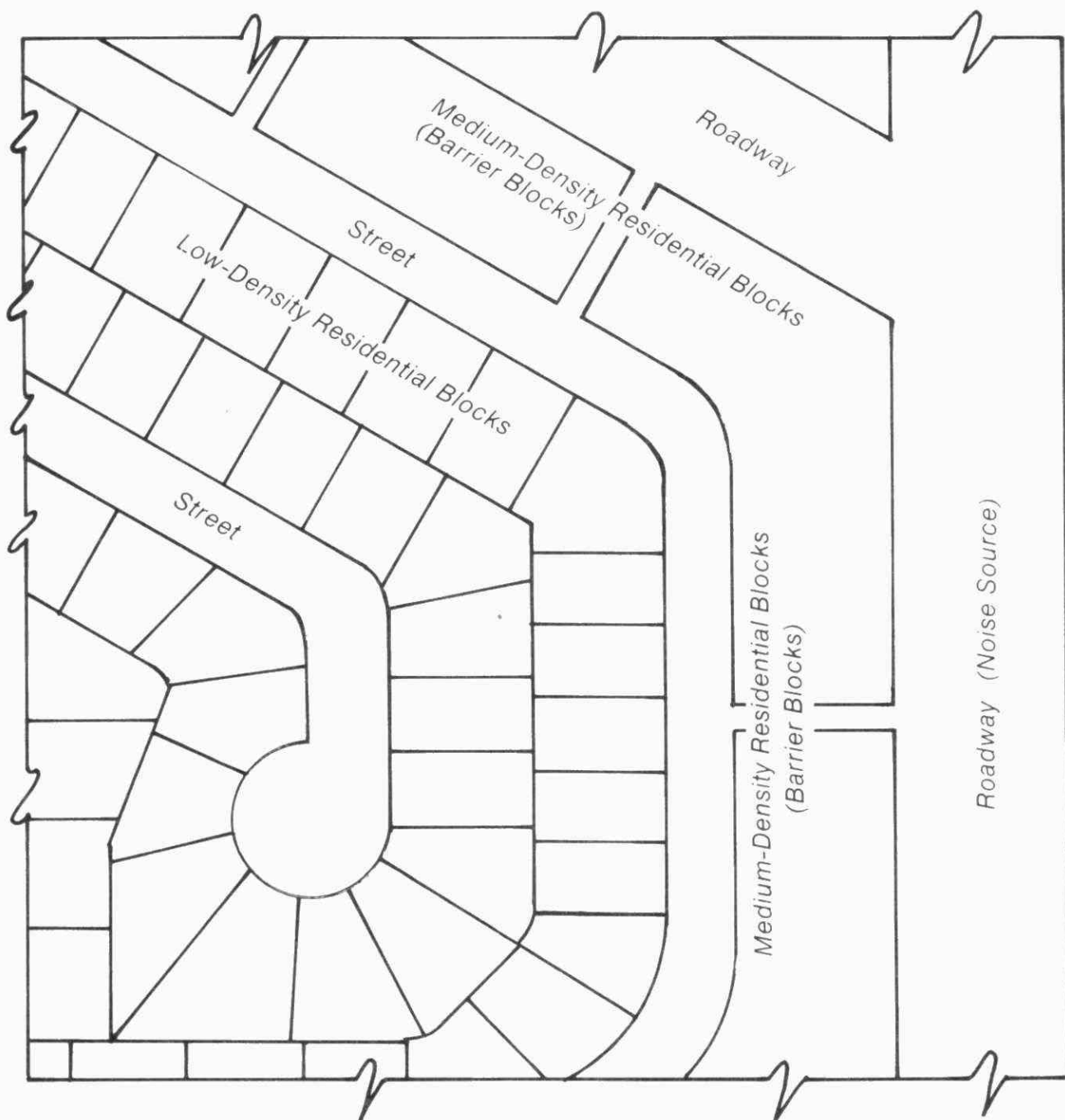


Figure 7.13 Typical Mixed Density Residential Development  
Illustrating the Use of Barrier Blocks to  
Protect the Entire Development



structures, whether related or unrelated to the site under consideration, could be treated as a site planning technique whereby the designer may rearrange the given layout to the benefit of the entire site. Due to the importance of this technique in creating an effective barrier, planners and designers are encouraged to utilize appropriate forms of buildings or structures to deliberately create acoustical shielding. The most powerful form of an intervening structure used as a noise control measure is that of a row of townhouses or an apartment block. It is this technique which forms the basis for a larger portion of the Barrier Tables. Such intervening structures, often called barrier blocks, are gaining wider acceptance as a method of developing lands subjected to hostile noise environments. This approach has been motivated not only for reasons of noise control but also as a demand exists today for row townhousing. In general, a desire for redevelopment in densely populated areas and the shortage of land for residential development in major population centres, suggest that it is possible to solve problems created by noise as long as the planner and designer are capable of using noise control techniques to mitigate adverse noise situations.

Barrier blocks offer a great advantage in that not only do they fulfill a useful role in protecting the site but, in addition, they provide positive land usage for the intended occupancy purpose (residential or commercial). The blocks need not be excessively high to be effective, although they should be to the minimum height given by the Barrier Tables to avoid excess noise levels above criteria. Even with medium density projects, a well designed barrier block consisting of a block of three to four storeys high, single aspect, dwellings may well be found sufficient to reduce external noise to an acceptable level throughout a site. One exception of this plan to note is when the road forming the source of noise is elevated, in which case the Tables may well indicate the need for a higher barrier building.

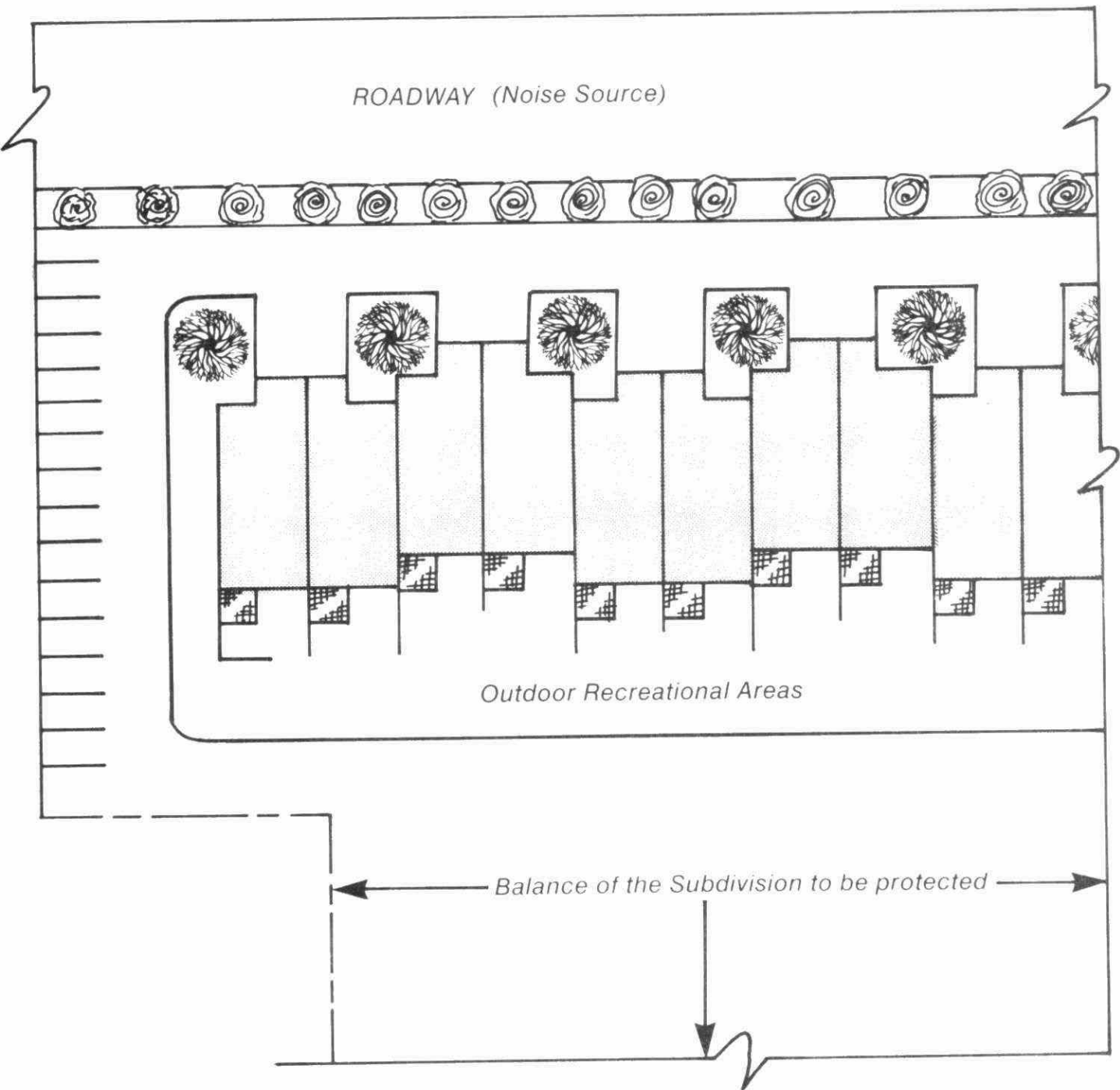


Figure 7.14 Typical Barrier Block Layout  
(straight line parallel to roadway)

As stated earlier, to be fully effective, barrier blocks must be continuous and as close to either the road or the area of dwellings to be protected as possible. For a given barrier block height, the closer the block is to the road, the smaller will be the area of site wasted on the noisy side of the barrier. Figure 7.13 illustrates how a typical mixed density residential development could be rearranged to provide such a barrier block. It must be realized that if a barrier building is used to protect a site, consideration must be given to protecting the indoor environment of these buildings from noise transmitted into them from the roadway side. Such protection is usually in the form of special glazing plus special ventilation or by internal building arrangement, placing corridors or other noise insensitive indoor areas on the roadway side. Such measures are discussed later in Sections 7.3 and 7.4.

Extreme care must be exercised when designing a barrier block to avoid undue noise exposure on dwelling units placed close to the ends of the barrier building and to minimize passageways and gaps between the barrier buildings, for access purposes or to fulfil fire control regulations and, finally, to avoid the presence of reflecting surfaces thus negating the effectiveness of the barrier. Figures 7.14 through 7.18 illustrate schematically typical barrier building layouts forming acoustical envelopes to protect the remaining areas of the site. It should be realized that such barrier buildings can take many designs and forms within the initial concept described here. It is the responsibility of the architect to produce acceptable designs within this concept.

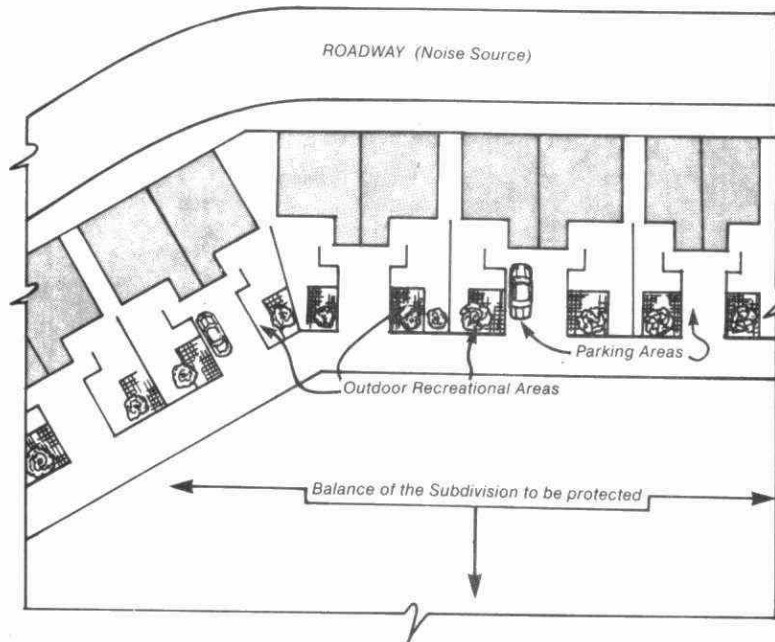


Figure 7.15 Typical Barrier Block Layout  
(Block ends turned in)

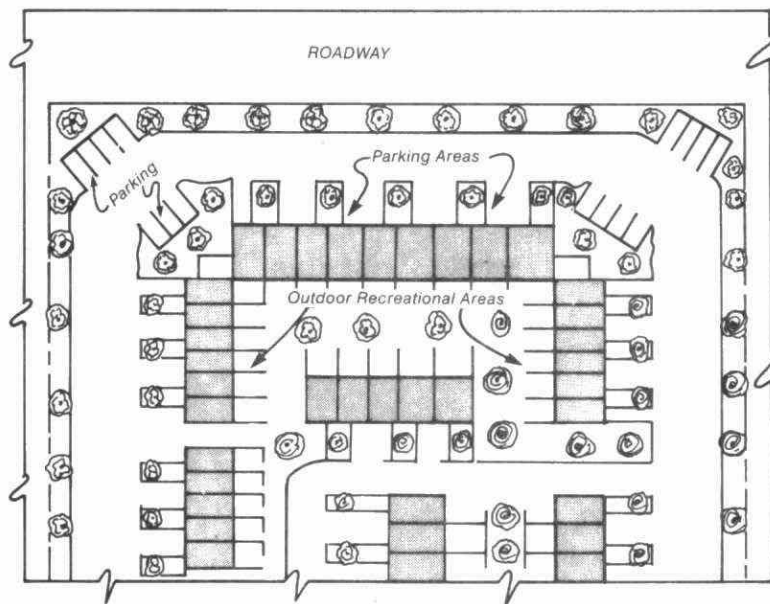


Figure 7.16 Typical Barrier Block Layout  
(U-Shaped Block)

### 7.3 ARCHITECTURAL DESIGN

This is an area where the architect and designer can use broad and effective noise control measures to achieve a satisfactory indoor environment in any building. The techniques described in this section are alternative to (and sometimes can be complementary to) the special construction techniques discussed in Section 7.4. Often it may be best to consider architectural design first to avoid the necessity of special construction features. If, however, the architectural design necessitates the design of non-standard dwellings or may result in poor aesthetics on the finished site, then special construction features on closely standard buildings should be examined. These architectural design features are mainly applicable to a barrier building (apartment blocks or townhouse row) to achieve a satisfactory indoor environment. They are, however, equally applicable to those floors on the rest of the site which are too high to be protected by the barrier building itself. Floors which are protected by the barrier building, as indicated by the Barrier Tables will, of course, not require any special architectural design features as discussed here.

#### 7.3.1 Blank Walls and Window Placement

Since blank walls, solid masonry or concrete walls give a significant reduction to sound waves as they pass from outdoors to indoors, they represent a simple method of achieving a satisfactory indoor noise environment despite the presence of an unsatisfactory outdoor environment. If conventional windows are placed in a blank wall, then the attenuation of sound produced by the wall/window combination is considerably reduced, glazing being the weak point so far as sound attenuation is concerned. Clearly in a barrier building, these factors can be optimised by using blank walls facing the roadway, all windows being oriented to the face of the building looking away from the roadway.



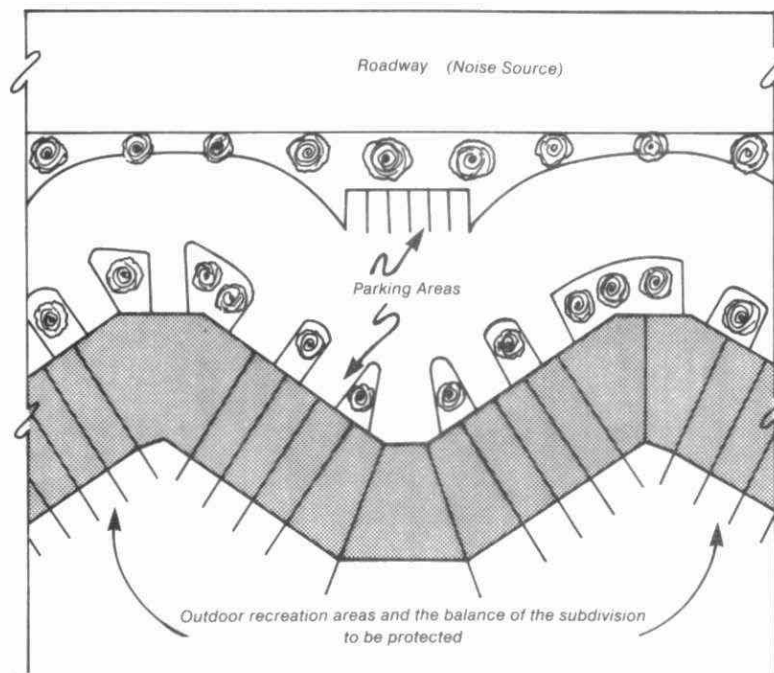


Figure 7.17 Typical Barrier Block Layout  
(Zig-zag Shaped Block)

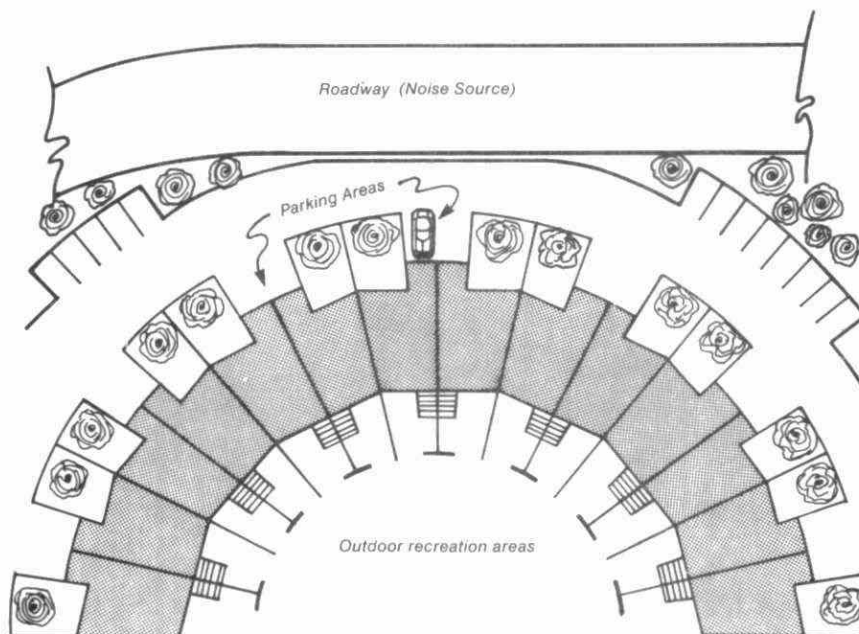


Figure 7.18 Typical Barrier Block Layout  
(Fan Shaped Block)

Walls perpendicular to the roadway will be subjected to noise levels only slightly less than walls actually facing the roadway and so these should be blank as well.

If blank walls are used in medium and high density residential developments such as single and multi-stacked townhouses and apartment blocks, then the buildings will have to be single aspect or "one sided". In some cases, this could result in individual units being slightly wider than conventional units to allow lighting and ventilation from one side only. The approach should not, however, present undue difficulty to the architect and designer since, in many cases, it would be possible to use similar internal layouts as are used for double aspect (two sided) apartment blocks or back-to-back townhouses where each dwelling unit has only one frontage. In the case of single frontage dwelling units, standard techniques are widely used for ventilation and lighting from one side only and special design consideration is unnecessary for these two factors. Figure 7.19 shows a typical application of these techniques. In cases where the use of extensive blank walls is felt to be undesirable for practical or aesthetic reasons, then windows can be introduced into the noise facade of the building so long as the glazing is designed to give adequate sound insulation. These techniques are discussed in Section 7.4.

Figure 7.20 shows an example of cases where blank walls were ineffectively used as a noise control measure.

#### 7.3.2 Room and Corridor Arrangement

Noise impact can be effectively reduced by separating noise sensitive rooms from less noise sensitive rooms, and placing the former in the part of the building which is further away from the road traffic noise. The less sensitive room or spaces, should then be placed closest to the noise

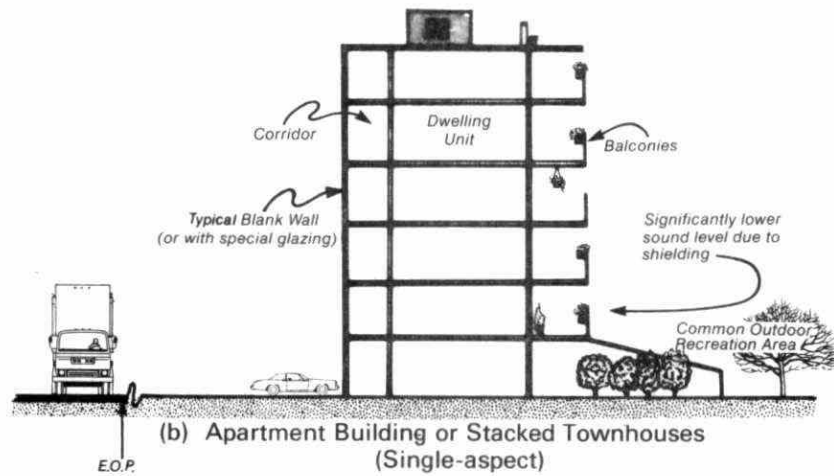
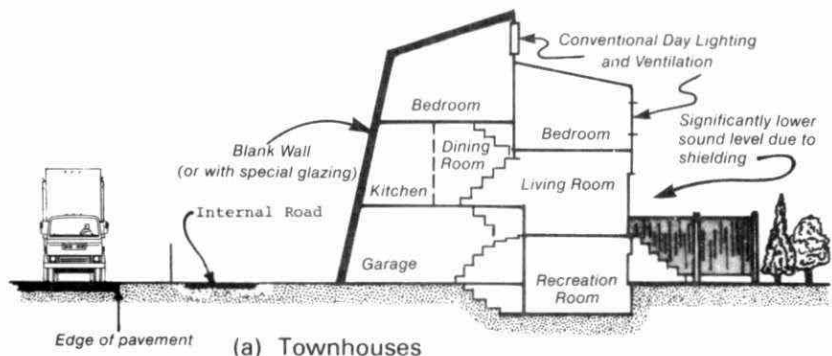


Figure 7.19 The Use of Blank Walls in Barrier Buildings or Blocks

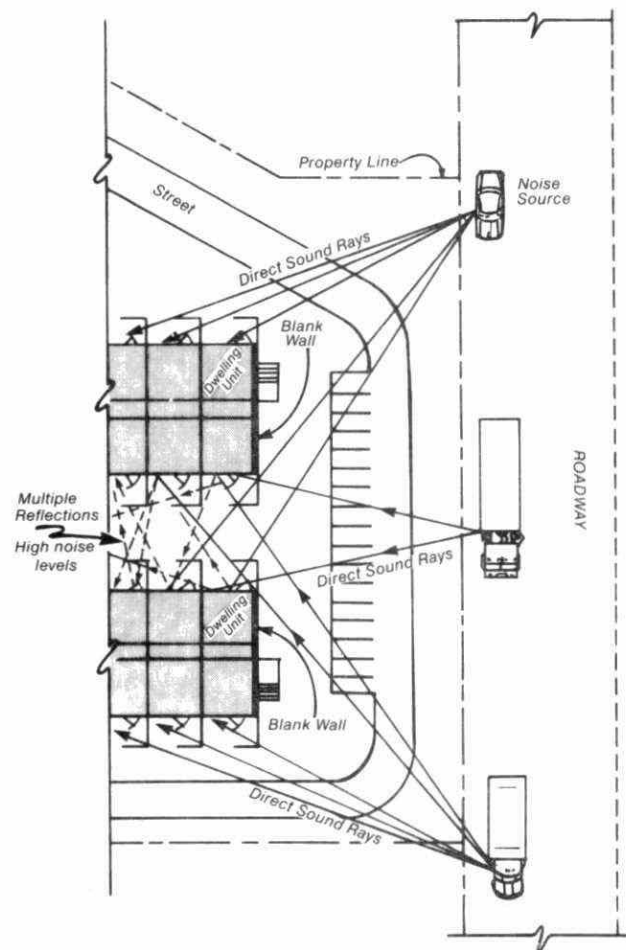


FIGURE 7.20 INEFFECTIVE USE OF BLANK WALLS

source where they can act as noise buffers for the more sensitive rooms. Typically, noise sensitive rooms include bedrooms, living rooms, recreation rooms and dens where such activities as sleeping, speech communication, watching television, listening to music and relaxation demand a superior noise environment. Kitchens and bathrooms are not as noise sensitive as the rooms already mentioned, but should be classed as noise sensitive in any case; kitchens in particular could well be occupied for a considerable portion of the day, especially if they are also used for eating purposes.

Noise insensitive rooms, or spaces, include corridors, stairways, separate entrances, garages, storage and garbage areas.

#### 7.3.3 Placement of Balconies, Terraces and Courtyards

Balconies, terraces and courtyards are areas located outside dwelling units for the enjoyment of the outdoor environment and as such should not be subjected to unduly high noise levels. Certain types of balcony facing the roadway may reflect roadway noise directly into the interior of the building as well as being rendered unacceptable in themselves due to high exterior noise levels. Such problems are particularly applicable to high and medium rise apartment buildings and stacked townhousing where balconies or terraces are common. If balconies and terraces are desired, the architect should avoid problems due to high noise levels by placing them on the quiet side of the building. This solution is plausible in the case of stacked townhousing where the terrace or balconies could be moved from the front to back or vice-versa, internal arrangements perhaps also being changed to suit. However, when this solution cannot be applied in dual-aspect of double-loaded buildings, other solutions such as providing a common outdoor recreational area shielded by the building instead of balconies, should be investigated.

## 7.4 CONSTRUCTION TECHNIQUES

As stated in Section 7.3, special construction techniques are very often alternatives to architectural design and fulfil very similar roles. These construction techniques often allow protection of the indoor environment of a residential unit which can be of conventional design. In some cases, both special construction techniques and architectural design can be used together in the same unit to achieve an acceptable living environment. An acceptable living environment as far as noise is concerned is defined in Table 131-1 in Appendix B. This gives a set of recommended sound level limits which should be met, for the time periods indicated, in the rooms listed. The measures discussed below should be specially designed to lower indoor noise levels to these values. The services of an acoustical consultant may well be required to this end.

### 7.4.1 Acoustical Treatment of Walls, Windows, Roofs, Doors and Ceilings

Acoustical treatment of a building facade which faces a noise source (or is at such a height as to remain unprotected by a barrier or barrier building) is an alternative to the blank wall approach discussed in section 7.3.1. As stated in that section, a blank wall will usually provide sufficient insulation to ensure a reasonable indoor environment. However, if windows (and doors or any other openings) are introduced into the wall then the attenuation could be greatly reduced rendering the indoor noise environment unacceptable. To avoid this possibility, the facade glazing (and doors) should be carefully designed to ensure that they have sufficient attenuation to give acceptable indoor noise levels.

A detailed presentation of acoustical insulation is beyond the scope of this text, but some of the main techniques



of obtaining sufficient noise attenuation from a window are given below:

- i) the sealing of standard windows in the building facade;
- ii) reduction of window size;
- iii) increasing the glass thickness;
- iv) use of double glazed windows with the appropriate air space width between panes;
- v) as in (iv) but a totally sealed unit.

#### 7.4.2 Air Conditioning and Ventilation

The glazing measures outlined in section 7.4.2 will only achieve their full design noise attenuation potential if the windows are fully closed (some of the measures preclude any window opening). To make up for the loss of ventilation incurred, it is often necessary to supply alternative ventilation. This may be done with forced air ventilation or air conditioning or ventilation through openable windows on the quiet side of the building.

#### 7.4.3 Construction Quality

The quality of construction cannot be sufficiently stressed in achieving maximum sound attenuation indoors. All the positive structural noise control measures discussed above may be reduced in effectiveness by poor workmanship and improper jointing, caulking and acoustical insulating practices. Strict energy conservation principles and insulation standards apply equally to preserving the acoustical insulating qualities of the structure.



## 8. THEORETICAL BACKGROUND

### 8.1 Traffic Noise Level Prediction

Traffic noise levels were predicted using the Ontario Highway Noise Prediction Method (Report No. RR 197) published by the Ontario Ministry of Transportation and Communications.<sup>(11)</sup> Both the  $L_{50}$  and  $L_{10}$  levels were computed using the following formulae:

$$L_{50} = 30.4 + 14.5 \log_{10} (V_c + 3V_t) - 11.5 \log_{10} D + 0.16S$$

$$L_{10} = 52.7 + 11.2 \log_{10} (V_c + 3V_t) - 14.8 \log_{10} D + 0.21S$$

Where  $V_c$  = the number of automobiles per hour

$V_t$  = the number of trucks per hour

$D$  = the distance from the edge of the pavement (EOP) to the receiver (ft), and

$S$  = the average or posted speed (m.p.h.) of traffic flow during an hour

The equivalent energy continuous sound level ( $L_{eq}$ ) was then calculated from the two parameters using the following equation:

$$L_{eq} = L_{50} + 0.070 (L_{10} - L_{50})^2$$

This equation applies strictly only for Gaussian or normal distributions. Traffic noise is usually closely Gaussian and thus the equation is applicable to this work.<sup>(12)</sup> However, the equation should not be taken to apply to other situations as errors may result. As  $L_{10}$  is usually very well correlated with  $L_{eq}$  for traffic flows, it is found that in most cases only the predicted  $L_{eq}$  values are required to determine the annoyance due to particular traffic noise levels. In other cases, however, it is necessary to look at both the  $L_{eq}$  and  $L_{50}$  values.<sup>(12) (19) (20)</sup>

## 8.2 SOUND LEVEL LIMITS

At higher levels of noise exposure, complaints and adverse community response results.<sup>(14,22,23)</sup> Figure 3.3 illustrates the extent of noise control measures required to combat noise levels in excess of the design sound level limits recommended by the Noise Pollution Control Section of the Pollution Control Planning Branch, Ministry of the Environment.

In the Model Municipal Noise Control By-Law, revised August, 1977<sup>(21)</sup> only two sound descriptors,  $L_{eq}$  and  $L_{50}$  have been adopted for use in the technical Publication NPC-131, Guidelines for Noise Control in Land Use Planning. The following limits are recommended.

An  $L_{eq} = 55$  dBA sound level limit, referenced to the entire 16 hour daytime period from 07:00 hr to 23:00 hr is applicable in all cases while the  $L_{50} = 52$  dBA sound level limit, referenced to the same daytime period above, need only be considered for those developments where the predominant sound is from industry or a roadway producing near constant sound levels. (See Appendix B)

The nighttime recommended sound level design limits were not considered in compiling the Tables because, in most cases, traffic flows and hence noise levels decrease at night.

The recommended design sound level limits chosen by the Ministry of the Environment are supported by international usage and by specific community noise studies carried out in Ontario since 1972.<sup>(12,15,22)</sup>

The daytime(07:00 hrs to 23:00 hrs) design limits chosen for Ontario are as follows:- (See also 8.6)

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$L_{eq}$	=	55 dBA
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$L_{50}$	=	52 dBA
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### 8.3 CALCULATION OF DBA EXCESS

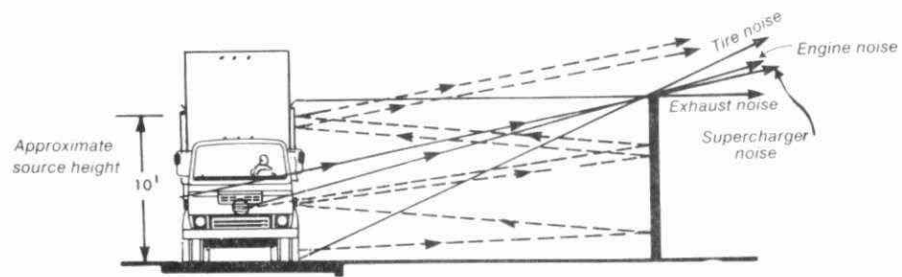
The predicted  $L_{eq}$  and  $L_{50}$  levels were compared to the respective  $L_{eq}$  and  $L_{50}$  sound level limits and two dBA excesses found. The greater dBA excess was taken as being the excess above recommended sound level limits for each particular situation. It is the dBA excess which is presented in the Red Flagging Tables, Section 5, for each value of distance, traffic flow, speed, truck percentage and roadway gradient.

### 8.4 BARRIER CALCULATION

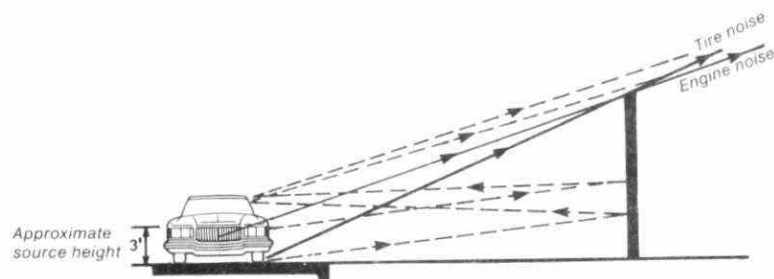
Barrier calculations for each site situation were performed according to the method of Kurze and Anderson.<sup>(16)</sup> Basically this method consists first of calculating the path length difference (PLD) due to the deflection of the sound ray from the direct source/receiver path by the barrier. Secondly, the path length difference is converted to Fresnel number form by dividing by half the wavelength of the sound. Finally the Fresnel number is converted to a dBA attenuation due to the presence of the barrier. This procedure will now be described in detail.

#### 8.4.1 Source Height

Traffic is a complicated mixture of many noise sources located at differing heights above the roadway surface as shown on Figure 8.1. The main noise sources are tire noise, located close to the roadway and exhaust noise which can be as high as 12 feet above the roadway surface. For a given barrier situation, the higher the source height the less effective the barrier will be and the lower its attenuation. A further problem is that the barrier, although providing attenuation by deflecting the sound ray, also reduces the ground attenuation of the sound as shown schematically in Figure 8.2. To take account of both of these effects, a source height of 10 feet above the roadway surface was assumed for all the barrier calculations in this work for roadways normally carrying truck traffic.

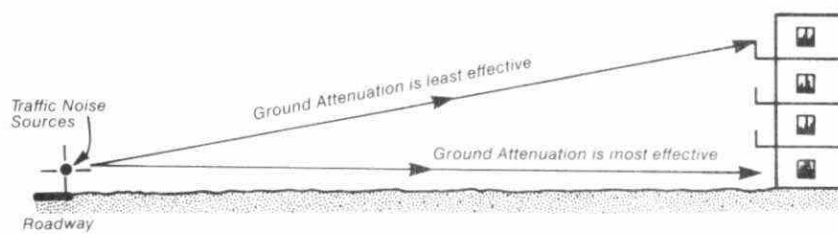


(a) Truck Noise Sources

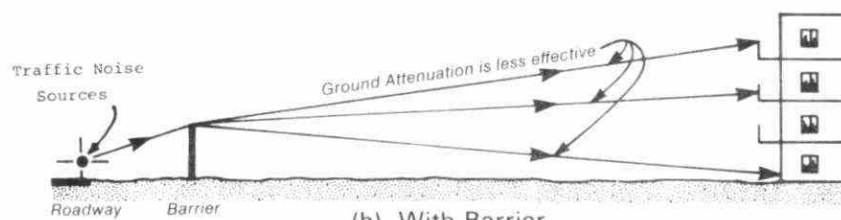


(b) Automobile Noise Sources

Figure 8.1 Sources of Traffic Noise



(a) No Barrier



(b) With Barrier

Figure 8.2 Effect of a Barrier on Ground Attenuation of Traffic Noise



#### 8.4.2 Types of Barrier and Barrier Geometry

Two distinct barrier types were used in the barrier attenuation calculations.

- (1) The first type is a "thin" barrier composed of a wall, solid acoustical fence, berm, berm/wall combination or berm/acoustical fence combination. The geometry of the thin barrier situation is shown in Figure 8.3. The barrier is placed on the site boundary which is taken as being 65 feet from the rear face of the dwelling unit. Unfortunately, it is not possible to directly obtain the barrier height ' $h_b$ ' required to give certain attenuation. For this reason the barrier attenuation given by barrier heights, increasing at one foot intervals were calculated and that height taken which gave the required attenuation. The Path Length Difference was calculated as follows:

$$PLD = a + b - d$$

$$\text{where } a = \{[h_b - (h_h + 10)]^2 + [D - 65]^2\}^{\frac{1}{2}}$$

$$b = \{(h_b - h_r)^2 + 65^2\}^{\frac{1}{2}}$$

$$d = \{[(h_h + 10) - h_r]^2 + D^2\}^{\frac{1}{2}}$$

and where

$D$  = The horizontal distance, in feet, between the traffic noise source and receiver

$h_h$  = The roadway elevation or depression, in feet

$h_b$  = The barrier height required to remove the dBA excess above sound level limits as obtained from the traffic noise prediction, in feet

$h_r$  = The receiver elevation, typically 6 ft. for 1st floor level, 15 ft. for 2nd floor level or 24 ft. for 3rd floor level.

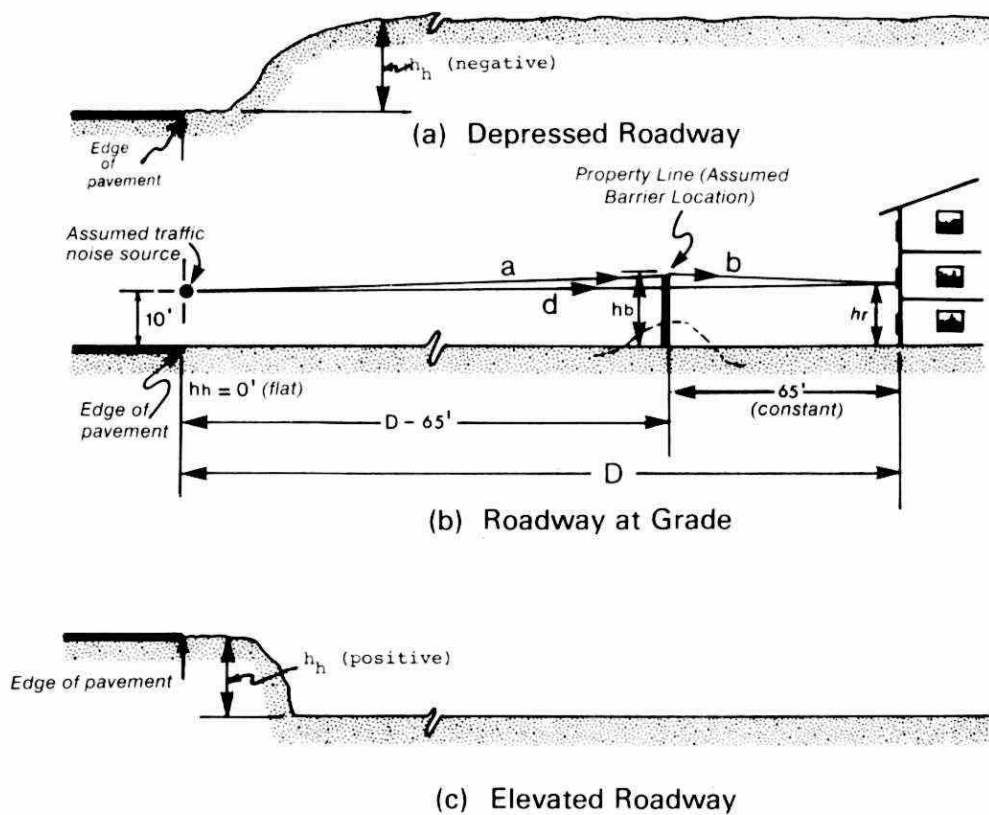


Figure 8.3 Geometry of a 'Thin' Barrier

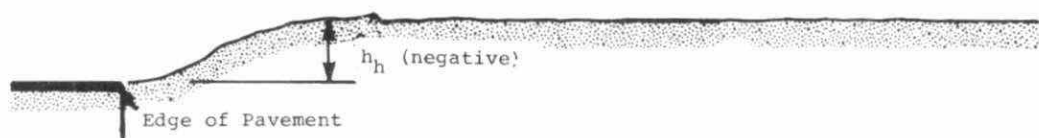
- (ii) The second type of barrier is a "thick" barrier composed of, typically, a fairly continuous row of townhouses or a row of apartment or commercial building blocks oriented parallel to the roadway. The geometry of the thick barrier situation is shown in Figure 8.4. Again in this situation  $D$  is the distance in the traffic noise prediction. The barrier row is separated from the site boundary by probably, a road access and parking. The distance from the roadway face of the barrier row and the first row of normal housing is taken as being 215 feet (typically one building width and two backyard depths). Similarly,  $h_h$  is the roadway elevation or depression and  $h_b$  the barrier row height required to remove the dBA excess over sound level limits as obtained from the traffic prediction.

Again, the iterative calculation must be performed to obtain the required height. In this case, the increment taken for each calculation was  $4\frac{1}{2}$  feet, approximately  $\frac{1}{2}L$  of a split level housing unit. The maximum reasonable height of a "thin" barrier was taken to be 15 feet. Thick barriers were taken as being between 18 feet ( $2L$  or two floors) and 63 feet ( $7L$  or seven floors) high, calculated in  $4\frac{1}{2}$  foot increments.

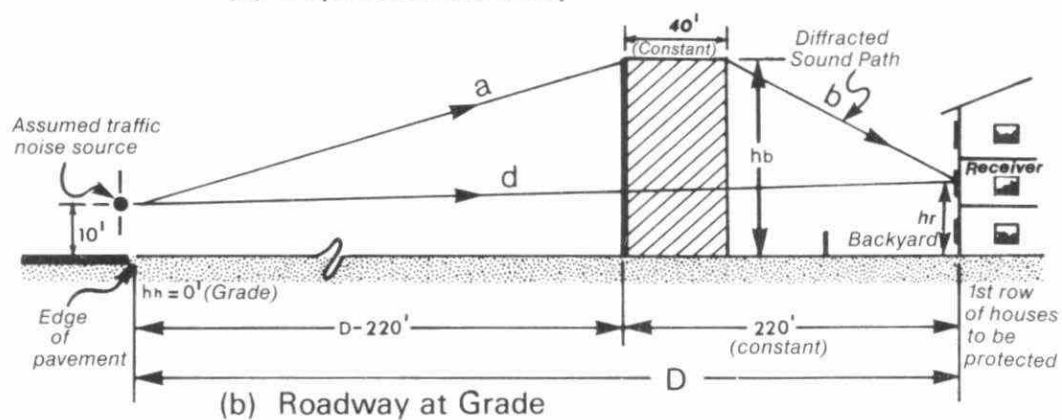
The PLD was calculated as follows for a barrier block<sup>(17)</sup>:

$$PLD = a + b + 40 - d$$

where 40 (feet) is the typical width of building and where



(a) Depressed Roadway



(b) Roadway at Grade



(c) Elevated Roadway

Figure 8.4 Geometry of a 'Thick' Barrier

$$\begin{aligned}
 a &= \{ [h_b - (h_h + 10)]^2 + (D - 220)^2 \}^{\frac{1}{2}} \\
 b &= \{ (h_b - h_r)^2 + 180^2 \}^{\frac{1}{2}} \\
 d &= \{ [(h_h + 10) - h_r]^2 + D^2 \}^{\frac{1}{2}}
 \end{aligned}$$

(Strictly speaking this method of calculating PLD does not follow the method in reference (14) but should give reasonable accuracy for this type of "thick" barrier).

#### 8.4.3 Calculation of Barrier Attenuation From PLD

Having obtained the PLD from the barrier situation geometry, PLD is converted to Fresnel Number form as follows:

$$\text{Fresnel Number (N)} = \frac{2 \times \text{PLD}}{\lambda}$$

where  $\lambda$  is the wavelength of the sound under consideration.

$$\text{Now } \lambda = \frac{c}{f}$$

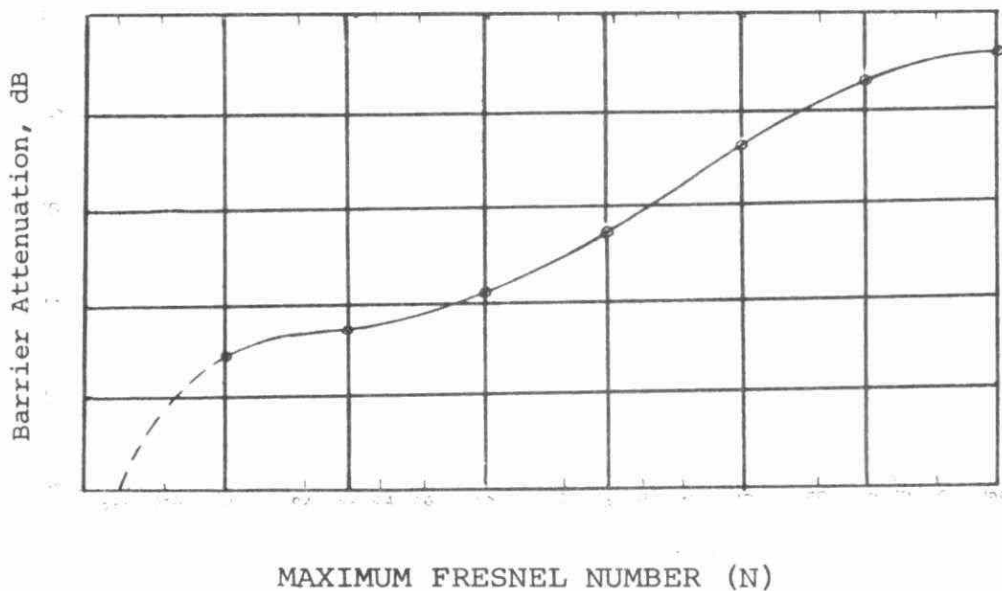
where 'c' is the speed of sound in air, 1128 ft./sec.

and 'f' is a representative frequency.

For traffic noise, a frequency of 500 Hz is used.

$$\text{Therefore, at 500 Hz, } \lambda = \frac{1128}{500} = 2.25 \text{ ft.}$$

$$\text{and } N = \frac{\text{PLD}}{1.13}$$



- Seven points used for fitting a polynomial to the Kurze and Anderson Curve, (16)
- A curve extrapolated from the developed polynomial fitted to the indicated seven points on the Kurze and Anderson Curve

Figure 8.5: Attenuation versus Fresnel Number (N) for sound waves that arrive from an infinitely long, incoherent line source parallel to the edge of a rigid barrier.



The attenuation in dBA for a particular value of Fresnel Number is shown in Figure 8.5. This graph applies for an infinitely long incoherent line source and is applicable to traffic flow.

For computational purposes seven points were taken from this curve (as shown in Figure 8.5) and a seven term polynomial expression fitted to the curve. The attenuation (L) in dBA is given as follows:

$$L = 10.6 + 6.15n + 3.05n^2 - 2.04n^3 - 0.70n^4 + 1.39n^5 - 0.45n^6$$

where  $n = \log_{10} N$

and  $N = \text{Fresnel Number}$

No information is given by Kurze and Anderson for barrier attenuation outside the range shown in Figure 8.5. To make up for this deficit, the seven term polynomial expression for the attenuation was also used for values of  $N$  less than 0.1. The expression decreases rapidly in this range and becomes zero at  $N = 0.040$  as shown by the dashed line in Figure 8.5.

#### 8.5 FLOW CHART FOR A TRAFFIC PREDICTION AND BARRIER CALCULATION PROGRAM

The flow chart represents a computer program for predicting traffic noise levels and required barrier heights according to the theory presented in this Section. The program may be useful for calculating other cases besides those contained in the Tables and, hence, the flow chart is written in a generalized way. The logic of the flow chart may, of course, be handled differently but the calculation methods are relatively standard.

The following notes on nomenclature and program detail may be of value:

- (i) Nomenclature is as previously listed in this Section plus:-

$V$  = Traffic volume in vehicles/day (Veh/day),

$T$  = Truck percentage,

$D_s$  = Edge of pavement (EOP) to front face of barrier distance, feet,

$t$  = Barrier thickness (townhouse barrier), feet,

$V_E$  = Effective traffic volume, vehicles/hour,

$L_E$  = Largest excess over recommended design sound level limits.

- (ii) The program calculates, first of all, the barrier height required to interrupt the line-of-sight between the source and the receiver and then increments the barrier height in one foot steps until any excess above the recommended design sound level limits is removed. In order to avoid taking the log of zero, it may be safest to round the first value of  $h_b$  upwards to the next whole number.

- iii) In the barrier calculation for a depressed roadway, a result of a barrier one foot high ( 1 ft. ) must not be considered negligible. This value has particular significance if the ground between the receiver and the barrier location is not level. The geometry assumed for the barrier calculation program is shown in Figure 8.7

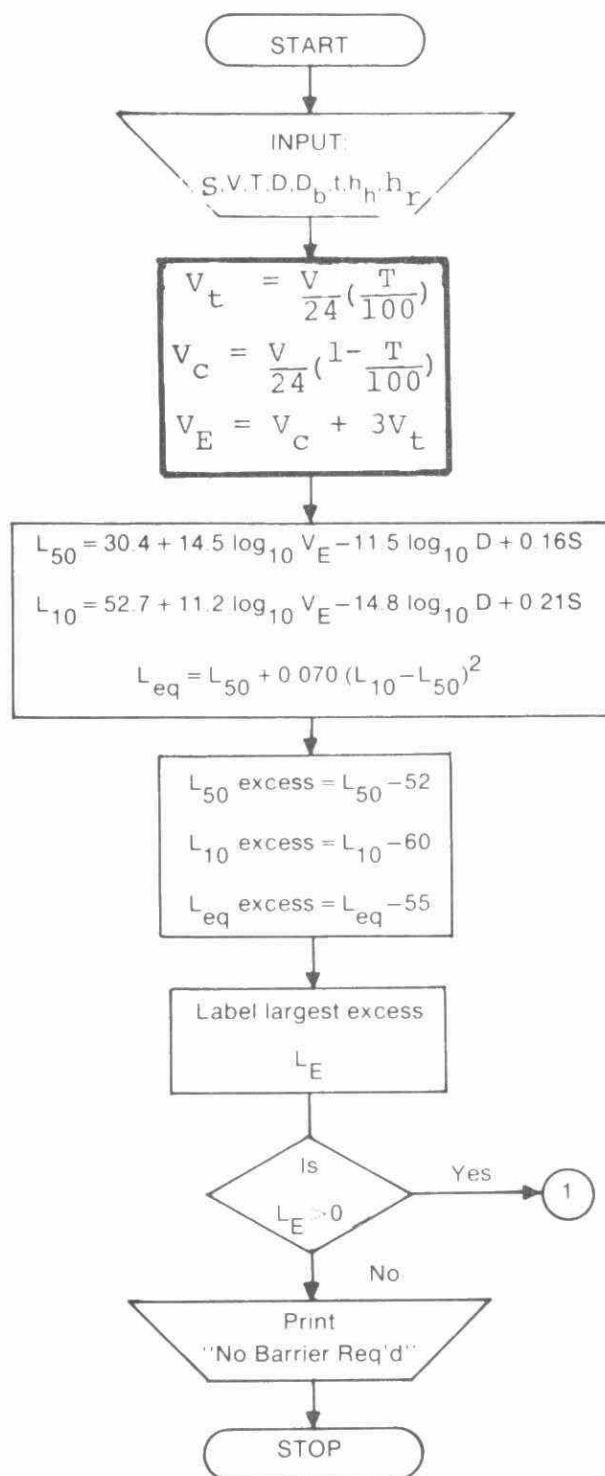


Figure 8.6.1. Highway Noise  
Prediction Flow  
Chart

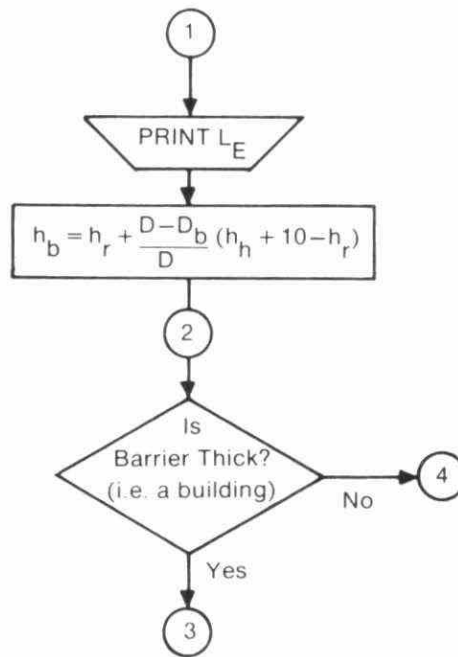


Figure 8.6.2. Barrier Calculation Flow Chart

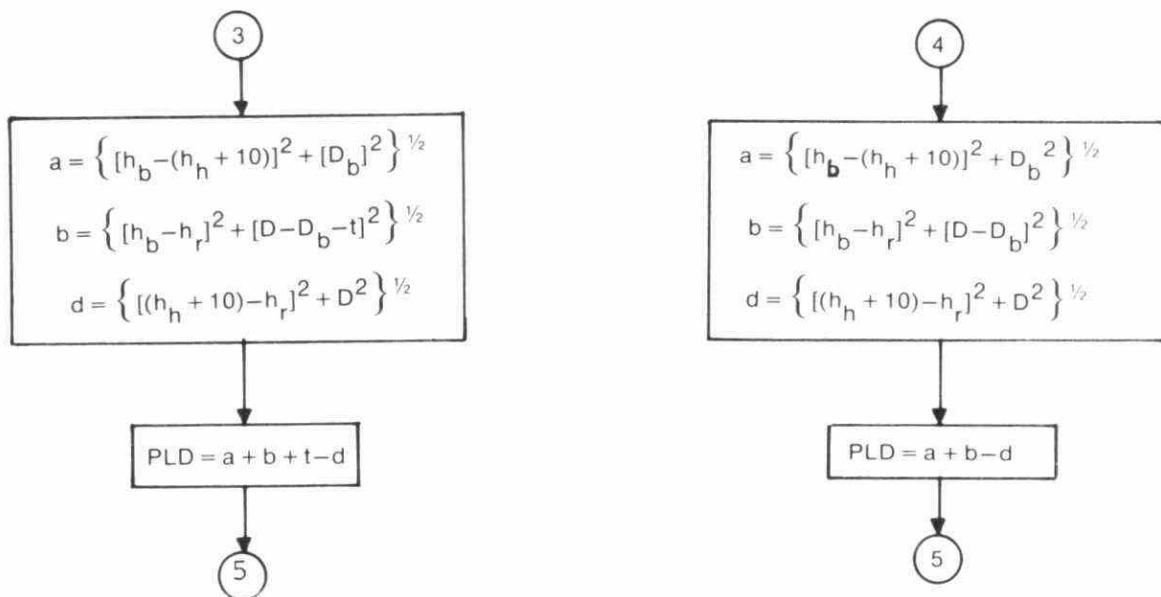


Figure 8.6.3. Barrier Calculation Flow Chart

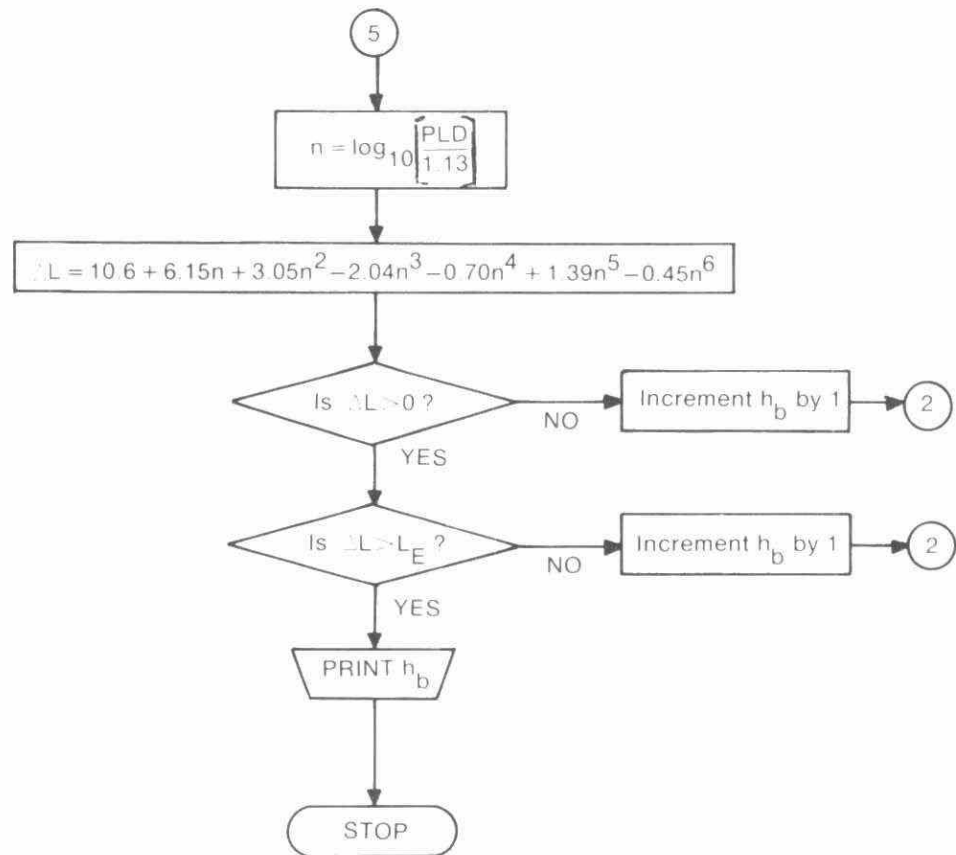


Figure 8.6.4. Barrier Calculation  
Flow Chart

- (iv) Work recently published<sup>(18)</sup> permits greater flexibility in the flow chart for predicting traffic noise levels. This may be useful in another jurisdiction where other design sound level limits may be considered. For example, to use a single  $L_{eq}$  or  $L_{dn}$  descriptor, the excess levels calculation equations shown in Figure 8.6.1. in the flow chart may be replaced, if desired, by one of the following:

$$(a) L_{eq} = 49.5 + 10.2 \log_{10}(V_c + 6V_t) - 13.9 \log_{10}D + 0.21 S$$

$$(b) L_{dn} = 38.2 + 10.2 \log_{10}\left[AADT + \frac{T\% AADT}{20}\right] - 13.9 \log_{10}D + 0.21 S$$

and correspondingly insert the appropriate limit:

$$L(a) \text{ excess} = L(a) - \text{design sound level limit}$$

$$L(b) \text{ excess} = L(b) - \text{design sound level limit}$$

- (v) The equations used here to predict  $L_{eq}$  and also those given in Reference (17) may well be in error for very low traffic volumes. For speed limits up to and including 40 mph and for traffic volumes ranging between 20 and 1,800 vehicles per hour use may be made of Publication NPC-129 which is part of the Model Municipal Noise Control By-Law, Revised August, 1977.<sup>(21)</sup>



## 8.6 Conversion Between 24 Hour $L_{eq}$ , 16 Hour $L_{eq}$ and $L_{dn}$

All the calculations of noise levels used to derive the Red Flagging Tables were based upon a traffic volume in vehicles per day, and hence all  $L_{eq}$  values calculated were 24 hour  $L_{eq}$ 's. It is the purpose of this Section to investigate the relationship of the 24 hour  $L_{eq}$  approach used in the Tables to other descriptors such as 16 hour  $L_{eq}$  (Daytime only) and  $L_{dn}$  (the day night sound level).

This is also necessary for a more basic reason. The 24 hour  $L_{eq}$  values obtained were compared to a daytime only  $L_{eq}$  sound level limit (55 dBA) which applies for only the 16 hour daytime period. The night time sound level limit (an 8 hour  $L_{eq}$  = 50 dBA) which is recommended was not considered in the preparation of these Tables. (See Appendix B, Tables 131-2 and 131-3).

### 8.6.1. Relationship Between 24 Hour $L_{eq}$ and 16 Hour $L_{eq}$

In order to answer this question, one can expect that an  $L_{eq}$  value will depend on the term  $10 \log_{10} V$  where  $V$  is the traffic volume. This is easily supported from energy considerations, twice the energy giving a 3 dBA increase in level and so on. Further information is required on the division of the 24 hour traffic volume by day and night periods. Such information was extracted from the traffic information guide<sup>(2)</sup>:

	<u>Day</u>	<u>Night</u>
Commuter routes	92%	8%
Tourist routes	89%	11%

In calculations which follow, only the  $10 \log_{10} V$  term of the  $L_{eq}$  evaluation will be considered, all other parameters being held constant from one situation to another for comparison purposes.

For commuter routes:

$$\begin{aligned} L_{eq}^{24} &= 10 \log 100\% = 20.0 \text{ dB} \\ L_{eq}^{16} &= 10 \log 92\% = 19.6 \text{ dB} \end{aligned}$$

For tourist routes:

$$\begin{aligned} L_{eq}^{24} &= 10 \log 100\% = 20.0 \text{ dB} \\ L_{eq}^{16} &= 10 \log 89\% = 19.5 \text{ dB} \end{aligned}$$

Thus, because traffic flows on typical tourist and commuter routes decrease at night, an  $L_{eq}$  based on 24 hour traffic figures will be within 0.5 dB of an  $L_{eq}$  based on 16 hour traffic figures irrespective of the traffic volumes. This result gives rise to two useful points:

- a) A 24 hour traffic volume can be used to calculate an  $L_{eq}$  value which, in turn, can be compared with a daytime only sound level limit. (This was assumed in the Table design)
- b) Either a 16 hour daytime traffic volume or a 24 hour volume can be used as data input to the Tables. (The error introduced is negligible).

### 8.6.2. Relationship Between 24 Hour $L_{eq}$ and $L_{dn}$

---

A descriptor which is finding use (particularly in the United States) is the day-night sound level or  $L_{dn}$ . This is basically a composite of daytime and nighttime  $L_{eq}$  's with a 10 dB weighting for the nighttime (22:00 - 07:00) hours.

$L_{dn}$  is calculated as follows:

$$L_{dn} = 10 \log_{10} \frac{1}{24} [15 \times 10^{(0.1 L_D)} + 9 \times 10^{0.1(L_N+10)}]$$

where  $L_D = L_{eq}$  for daytime (from 07:00 to 22:00 hours), dBA

and  $L_N = L_{eq}$  for night time (from 22:00 to 07:00 hours), dBA

An effective  $L_{dn}$  sound level limit can be calculated from this formula using a day  $L_{eq}$  limit of 55 dBA and a night  $L_{eq}$  limit of 50 dBA, as follows:

$$\begin{aligned} L_{dn} &= 10 \log_{10} \frac{1}{24} [15 \times 10^{0.1 \times 55} + 9 \times 10^{0.1(50+10)}] \\ &= 57.6 \approx 58 \text{ dBA} \end{aligned}$$

Thus a daytime  $L_{eq}$  limit of 55 dBA and a nighttime limit of 50 dBA correspond to a combined  $L_{dn}$  58 dBA limit. However, before this conversion can be used, the traffic figures used in the Tables must themselves be weighted according to the  $L_{dn}$  method, that is nighttime traffic given the 10 dB weighting. To do this calculation, let  $V_d$  be the daytime traffic volume and  $V_n$  the nighttime traffic volume. Then,

$$L_{dn} = 10 \log_{10} \frac{1}{24} [15 \times 10^{0.1(10 \log_{10} V_d)} + 9 \times 10^{0.1(10 + 10 \log_{10} V_n)}]$$

which simplifies to,

$$L_{dn} = 10 \log_{10} \frac{1}{24} [15V_d + 90V_n]$$

thus, for commuter routes,  $V_d = 92\%$  of  $V$ ;  $V_n = 8\%$  of  $V$ ;

$$\begin{aligned} L_{dn} &= 10 \log_{10} \frac{1}{24} [15.(0.92) + 90.(0.08)] \\ &= 19.4 \text{ dB} \end{aligned}$$

and for tourist routes,  $V_d = 89\%$  of  $V$ ;  $V_n = 11\%$  of  $V$ ;

$$\begin{aligned} L_{dn} &= 10 \log_{10} \frac{1}{24} [15.(0.89) + 90.(0.11)] \\ &= 19.9 \text{ dB} \end{aligned}$$

These values are then compared with the previously calculated 24 hour  $L_{eq}$  of 20 dBA. Thus, difference between  $L_{dn}$  values for commuter and tourist routes <sup>(2)</sup> and 24 hour  $L_{eq}$  values are less than 0.6 dBA. Therefore, approximately speaking, when dealing with  $L_{eq}$  excesses in the Red Flagging Tables, these excesses correspond to excesses above an  $L_{dn}$  sound level limit of 58 dBA. Thus, within the errors discussed, both the Red Flagging Tables and the Sound Barrier Tables may both be assumed to give excesses above  $L_{dn} = 58 \text{ dBA}$ .

## 8.7 COMPARISON OF DESIGN CRITERIA

To recapitulate, a comparison of design criteria used and which may be successfully used without altering the Tables, may be useful at this time:

- i) The design sound level limits for both the RED FLAGGING TABLES and the SOUND BARRIER TABLES are:-

$$\begin{aligned} \underline{L_{eq}(24 \text{ hr})} &= 55 \text{ dBA} \\ L_{50}(24 \text{ hr}) &= 52 \text{ dBA} \end{aligned}$$

- ii) The design sound level limits above have been shown to approximately equal the 16 hour daytime recommended design sound level limits proposed for new housing subdivisions in Ontario. (1,12,21,23)

- iii) Similarly;

$$\begin{aligned} L_{eq}(24 \text{ hr}) 55 \text{ dBA} &= L_{eq}(16 \text{ hr}) 55 \text{ dBA} \\ L_{eq}(24 \text{ hr}) 55 \text{ dBA} &= L_{dn} 58 \text{ dBA} \\ L_{eq}(24 \text{ hr}) 55 \text{ dBA} &= L_{eq} 57 \text{ dBA (Peak Hour)} \quad (24) \end{aligned}$$

- where '16 hr' and 'Peak Hour'  $L_{eq}$  refer to daytime only.  
iv) Design guidelines published by the Ministry of Housing refer to  $L_{eq}$  (Peak Hour) sound level limits. (24)

- v) Inaccuracies resulting from rounding off data (see 4.6) permit use of these Tables in other jurisdictions where  $L_{dn}$  is the preferred sound descriptor, as follows.  
Design sound level limit for Tables,  $\underline{L_{dn} = 60 \text{ dBA (say)}}$

- vi) Similarly, when impacts from road traffic noise and aircraft noise occur simultaneously the  $L_{dn}$  equivalent may be the preferred sound descriptor

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19. "THE EFFECTS OF TIME-VARYING SOUND ON SPEECH INTERFERENCE WITH REFERENCE TO THE SETTING OF SOUND LEVEL LIMITS FOR NEW RESIDENTIAL DEVELOPMENT" H. Gidamy and J.R. Hemingway, Ontario Ministry of the Environment, Internal Report, January 1977.
20. " $L_{50}$  AND  $L_{eq}$  AS A FUNCTION OF ROAD TRAFFIC PARAMETERS", H. Gidamy and J.R. Hemingway, Ontario Ministry of the Environment, Internal Report, February 1977.
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22. "COMMUNITY EFFECTS OF ROAD TRAFFIC NOISE", Experience '77 Report, F.L. Hall and S.M. Taylor, McMaster University, 1977.
23. "A FIELD STUDY OF HUMAN RESPONSE TO TRAFFIC NOISE", Transport Canada Report, J.S. Bradley, University of Western Ontario, 1977.
24. Design Noise Levels, Title 23 Highway, Chapter 1 - Federal Highway Administration, The Federal Register Volume 41. No. 80. April 1976.



APPENDIX A  
DEFINITIONS\*

Decibel

The "decibel" is a dimensionless measure of sound level or sound pressure level.

Sound Pressure Level

The "sound pressure level" is twenty times the logarithm to the base 10 of the ratio of the effective pressure (P) of a sound to the reference pressure ( $P_r$ ) of 20  $\mu$ Pa. Thus the sound pressure level in dB =  $20 \log_{10} \left( \frac{P}{P_r} \right)$

A-Weighting

"A-weighting" is the frequency weighting characteristics as specified in IEC 123 or IEC 179 and intended to approximate the relative sensitivity of the normal human ear to different frequencies (pitches) of sound.

A-Weighted Sound Pressure Level (Sound Level)

The "A-weighted sound pressure level" (sound level) is the sound pressure level modified by application of the A-weighting. It is measured in A-weighted decibels, denoted dBA.

Equivalent Sound Level ( $L_{eq}$ )

The "equivalent sound level" sometimes denoted  $L_{eq}$ , is the value of the constant sound level which would result in exposure to the same total A-weighted energy as would the specified time-varying sound, if the constant sound level persisted over an equal time interval. It is measured in dBA.

The 10th Percentile Sound Level ( $L_{10}$ )

The "10th percentile sound level", designated  $L_{10}$ , is the sound level exceeded 10 percent of a specified time period. It is measured in dBA.

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\* Other technical definitions and procedures are included in the Noise Pollution Control Publications specified in the Model Municipal Noise Control By-law, Revised May, 1976, Ministry of The Environment.

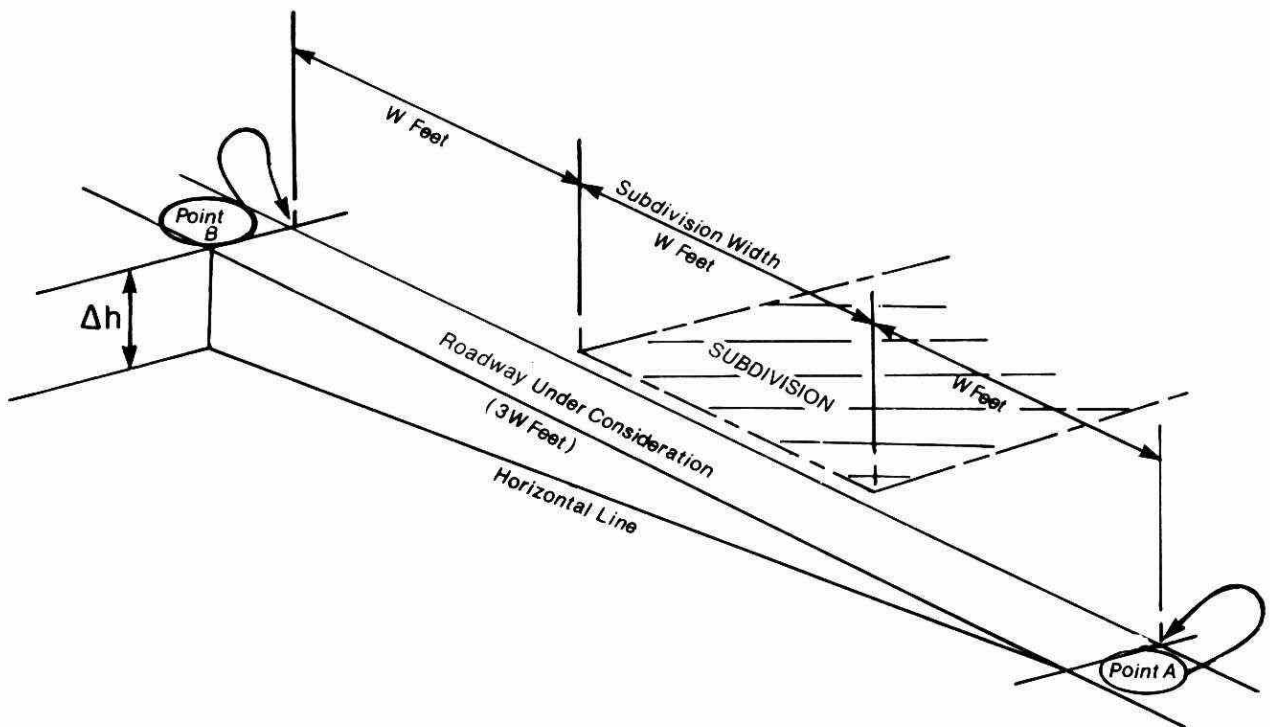


Figure 9.1

### The 50th Percentile Sound Level ( $L_{50}$ )

The "50th percentile sound level", designated  $L_{50}$ , is the sound level exceeded 50 percent of a specified time period. It is measured in dBA.

### Path Length Difference (PLD)

The "Path length difference" sometimes denoted PLD is the extra distance sound rays must travel due to the placement of a barrier between source and receiver.

### Roadway Grade (or Gradient)

The roadway grade (or gradient) refers to the slope of the road determined by dividing the difference in vertical elevation between two points on the roadway by the roadway distance between these two points and multiplying the result by 100 to express the grade as a percentage. For the purposes of these Tables, the Roadway Grade should be calculated using Points A and B shown in Fig. 9.1. Using this system, the roadway grade would be calculated as follows:

$$\text{Roadway Grade in \%} = \frac{\Delta h}{3W} \times 100$$

where  $\Delta h$  = difference in elevation between points A and B

W = subdivision width measured parallel to the roadway

thus  $3W$  = length of roadway between points A and B.





## APPENDIX B

### Publication NPC-131 (Model Municipal Noise Control By-law) Guidelines for Noise Control in Land Use Planning

#### 1. Scope

This Publication refers to the noise environment on the site of proposed residential or other sound-sensitive development in an urban area. Specified sound-level limits should apply to a new development as well as alteration to, or conversion of, any existing development or construction. Rural and special residential land use may be subject to different conditions. For sound-level limits on the site of a proposed residential or other sound-sensitive development influenced by aircraft noise, reference should be made to Publication NPC-126, Guidelines on Aircraft Noise.

#### 2. Definitions

##### (1) Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-101 - Technical Definitions.

##### (2) Definitions Specific to this Publication

###### (a) Outdoor Recreational Areas

"Outdoor recreational areas" refers to those outdoor areas where the enjoyment of the outdoor environment is important. These areas include, but are not limited to, the following:

- (i) yards including front yards, backyards, gardens, terraces or patios of dwellings;
- (ii) common outdoor areas allocated for recreational purposes such as areas outside apartment buildings, condominiums, group homes, hospitals and schools;
- (iii) parks and open spaces allocated for recreational purposes within a plan of subdivision.

(b) Control Measures

"Control measures" refers to actions which can be taken to achieve noise compatibility for the specific land use or activity. Control measures may include, but are not limited to, the following:

- (i) Site Planning - orientation of buildings and outdoor recreational areas with respect to noise sources, spatial separation such as insertion of sound-insensitive land uses between source and receiver and appropriate setbacks;
- (ii) Acoustical Barriers - berms, walls, favourable topographical features; other intervening structures;
- (iii) Architectural Design - room and corridor arrangement; blank walls, placement of windows, balconies and courtyards, building height;
- (iv) Construction - acoustical treatment of walls, ceilings, windows and doors, selection of acoustical materials and other control devices.

3. Indoor Sound Level Limits

- (1) Table 131-1 as adjusted in accordance with subsection (2) if necessary, gives the equivalent sound level ( $L_{eq}$ ) limits and the applicable time periods for the indicated types of indoor space. These are the minimum requirements of these Guidelines and apply in all cases.
- (2) When the predominant sound has pronounced tonal quality such as a whine, screech, buzz, or hum or contains pronounced narrow bands of energy, then 5 dBA should be deducted from the sound level limits indicated in Table 131-1.

#### 4. Outdoor Sound Level Limits

- (1) Table 131-2 gives the sound level limits for two descriptors,

the 50th percentile sound level ( $L_{50}$ ) and  
the equivalent sound level ( $L_{eq}$ )  
for outdoor recreational areas, where the descriptors are referenced to the entire 16 hour period from 07:00 to 23:00 hours. The 50th percentile need only be considered for developments where the predominant sound is industry or a highway producing near constant sound levels.

Compliance with these sound level limits should generally ensure compliance with the appropriate requirements of Table 131-1 for the same time period for any normal building construction nearby.

- (2) Table 131-3 gives the sound level limits for two descriptors,

the 50th percentile sound level ( $L_{50}$ ) and  
the equivalent sound level ( $L_{eq}$ ),  
for outdoor areas, in the vicinity of buildings or proposed buildings containing sleeping quarters, where the descriptors are referenced to the entire 8 hour period from 23:00 to 07:00 hours. The 50th percentile need only be considered for developments where the predominant sound is industry or a highway producing near constant sound levels.

Compliance with these sound level limits should generally ensure compliance with the appropriate requirements of Table 131-1 for the same time period for any normal building construction nearby.

- (3) Where the requirements of Table 131-3 cannot be met, special architectural design or construction features will have to be incorporated into the building construction to ensure compliance with the appropriate requirements of Table 131-1 for the same time period.

## 5. Planning the Project

### (1) Responsibility of Developer

The developer or proponent of a new project, or project to convert an existing use, for a residential or sound-sensitive development in an urban area, should be responsible for investigating both the outdoor and potential indoor acoustical environments, and to determine the feasibility and the constraints applicable before any project action is taken or construction commitment made.

### (2) Establishing the Sound Levels On-Site.

The sound levels anticipated on the site should be established by the use of prediction techniques acceptable to the Minister, based when necessary on actual measurements. In all cases, consideration should be given to anticipated future increases in sound levels for at least ten years.

### (3) Control Measures

When anticipated sound levels on the site of the land use development under consideration exceed the recommended sound level limits, the land developer should institute appropriate control measures or revision to plans.

### (4) Ventilation

When special architectural design or construction features are used as control measures and thereby restrict indoor ventilation, then air conditioning or forced air ventilation systems should be provided.

Table 131-1  
Indoor Sound Level Limits

Type of Space	Equivalent Sound Level dBA (L <sub>eq</sub> ),
Bedrooms, sleeping quarters, hospitals, etc. (Time period 23:00 - 07:00 hours)	40
Living rooms, hotels, motels, etc. (Time period 07:00 - 23:00 hours)	45
Individual or semi-private offices, small conference rooms, reading rooms, classrooms, etc. (Time period 07:00 - 23:00 hours)	45
General offices, reception areas, retail shops and stores, etc. (Time period 07:00 - 23:00 hours)	50

Table 131-2  
Sound Level Limits for Outdoor Recreational Areas (07:00-23:00 hours)

Sound Descriptor for the Entire Period	Sound Level Limit dBA
L <sub>50</sub>	52
L <sub>eq</sub>	55

Table 131-3  
Sound Level Limits for Outdoor Areas (23:00-07:00 hours)

Sound Descriptor for the Entire Period	Sound Level Limit dBA
L <sub>50</sub>	47
L <sub>eq</sub>	50

Other Publications of the Ministry of the Environment

- Model Municipal Noise Control By-Law
- Noise Pollution Control Publications
- Training Manuals
  - Environmental Acoustics Technology, I to IV
  - Acoustics Technology in Land Use Planning
    - Volumes I and II

Point of Sale

- All publications  
for sale at the:

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880 Bay Street  
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- The publications may also be ordered from:

The Publications Centre  
Ministry of Government Services  
880 Bay Street, 5th Floor  
Toronto, Ontario  
M7A 1N8



Number	Log	Number	Log	Number	Log	Number	Log
1.0	0.00	4.0	0.60	7.0	0.85	1	0
1.1	0.04	4.1	0.61	7.1	0.85	10	1
1.2	0.08	4.2	0.62	7.2	0.86	100	2
1.3	0.11	4.3	0.63	7.3	0.86	1000	3
1.4	0.15	4.4	0.64	7.4	0.87	10000	4
1.5	0.18	4.5	0.65	7.5	0.88	100000	5
1.6	0.20	4.6	0.66	7.6	0.88	1000000	6
1.7	0.23	4.7	0.67	7.7	0.89	etc.	
1.8	0.26	4.8	0.68	7.8	0.89	$10^0$	0
1.9	0.28	4.9	0.69	7.9	0.90	$10^1$	1
						$10^2$	2
2.0	0.30	5.0	0.70	8.0	0.90	$10^3$	3
						$10^4$	4
2.1	0.32	5.1	0.71	8.1	0.91	$10^5$	5
2.2	0.34	5.2	0.72	8.2	0.91	$10^6$	6
2.3	0.36	5.3	0.72	8.3	0.92	etc.	
2.4	0.38	5.4	0.73	8.4	0.92		
2.5	0.40	5.5	0.74	8.5	0.93		
2.6	0.41	5.6	0.75	8.6	0.93		
2.7	0.43	5.7	0.76	8.7	0.94		
2.8	0.45	5.8	0.76	8.8	0.94		
2.9	0.46	5.9	0.77	8.9	0.95		
3.0	0.48	6.0	0.78	9.0	0.95		
3.1	0.49	6.1	0.79	9.1	0.96		
3.2	0.51	6.2	0.79	9.2	0.96		
3.3	0.52	6.3	0.80	9.3	0.97		
3.4	0.53	6.4	0.81	9.4	0.97		
3.5	0.54	6.5	0.81	9.5	0.98		
3.6	0.56	6.6	0.82	9.6	0.98		
3.7	0.57	6.7	0.83	9.7	0.99		
3.8	0.58	6.8	0.83	9.8	0.99		
3.9	0.59	6.9	0.84	9.9	1.00		

Table of Logarithms

Log	Number	Log	Number	Log	Number	Log	Number
0.00	1.0	0.60	4.0	0.85	7.0	0	1
						1	10
0.04	1.1	0.61	4.1	0.85	7.1	2	100
0.08	1.2	0.62	4.2	0.86	7.2	3	1000
0.11	1.3	0.63	4.3	0.86	7.3	4	10000
0.15	1.4	0.64	4.4	0.87	7.4	5	100000
0.18	1.5	0.65	4.5	0.88	7.5	6	1000000
0.20	1.6	0.66	4.6	0.88	7.6		
0.23	1.7	0.67	4.7	0.89	7.7		
0.26	1.8	0.68	4.8	0.89	7.8	0	$10^0$
0.28	1.9	0.69	4.9	0.90	7.9	1	$10^1$
						2	$10^2$
0.30	2.0	0.70	5.0	0.90	8.0	3	$10^3$
						4	$10^4$
0.32	2.1	0.71	5.1	0.91	8.1	5	$10^5$
0.34	2.2	0.72	5.2	0.91	8.2	6	$10^6$
0.36	2.3	0.72	5.3	0.92	8.3		etc.
0.38	2.4	0.73	5.4	0.92	8.4		
0.40	2.5	0.74	5.5	0.93	8.5		
0.41	2.6	0.75	5.6	0.93	8.6		
0.43	2.7	0.76	5.7	0.94	8.7		
0.45	2.8	0.76	5.8	0.94	8.8		
0.46	2.9	0.77	5.9	0.95	8.9		
0.48	3.0	0.78	6.0	0.95	9.0		
0.49	3.1	0.79	6.1	0.96	9.1		
0.51	3.2	0.79	6.2	0.96	9.2		
0.52	3.3	0.80	6.3	0.97	9.3		
0.53	3.4	0.81	6.4	0.97	9.4		
0.54	3.5	0.81	6.5	0.98	9.5		
0.56	3.6	0.82	6.6	0.98	9.6		
0.57	3.7	0.83	6.7	0.99	9.7		
0.58	3.8	0.83	6.8	0.99	9.8		
0.59	3.9	0.84	6.9	1.00	9.9		

Table of Antilogarithms

Step 1: Speed =

Step 2: Truck Percent =

Step 3: Roadway Grade =

Data Value	Table Value Used
m.p.h.	m.p.h.
%	%
%	%

Step 4: Table to be used is

Number	-
--------	---

(a) from Fig. 3.7

from Fig. 3.8

(b) Traffic Volume =

Step 5: Distance =

Step 6: Road Elevation =

Data Value	Table Value Used
veh/day	veh/day
ft.	ft.
ft.	ft.

use minus sign for depressed road

Step 7:

		1st Row	2nd	3rd
Receiver Height (Floors)	1st			
	2nd			
	3rd			

Step 8: Data Value of Distance =

ft.	Table Value Used
+ 215 ft.	
ft.	ft.

∴ Increased Data Value of Distance =

		1st Row	2nd	3rd
Receiver Height (Floors)	1st			
	2nd			
	3rd			

REMARKS :

Step 1: Speed =

Data Value	Table Value Used
m.p.h.	m.p.h.
%	%
%	%

—see 3.1.1

Step 2: Truck Percent =

—see 3.1.2

Step 3: Roadway Grade =

—see Fig. 3.2

Step 4: Table to be used is

No. from Fig. 3.2

Step 5: 24 hour Traffic Volume =

veh/day

Step 6: Grooving?

Yes, 24 hour Traffic Volume x 3 =

veh/day

No, 24 hour Traffic Volume =

veh/day

Step 7: Distance =

ft.

Step 8: dBA excess =

dBA

—from Table

+ dBA

Traffic Volume  
Interpolation—see 3.1.3

– dBA

Distance Interpolation  
—see 3.1.4

Total dBA excess =

dBA

Step 9: Subjective Change in Loudness:

Magnitude of Noise Problem:

Necessity of Control Measures:

Step 10: Distance for no Control Measures:  
(assuming flat land)

ft.

REMARKS:

RED FLAGGING DATA SHEET